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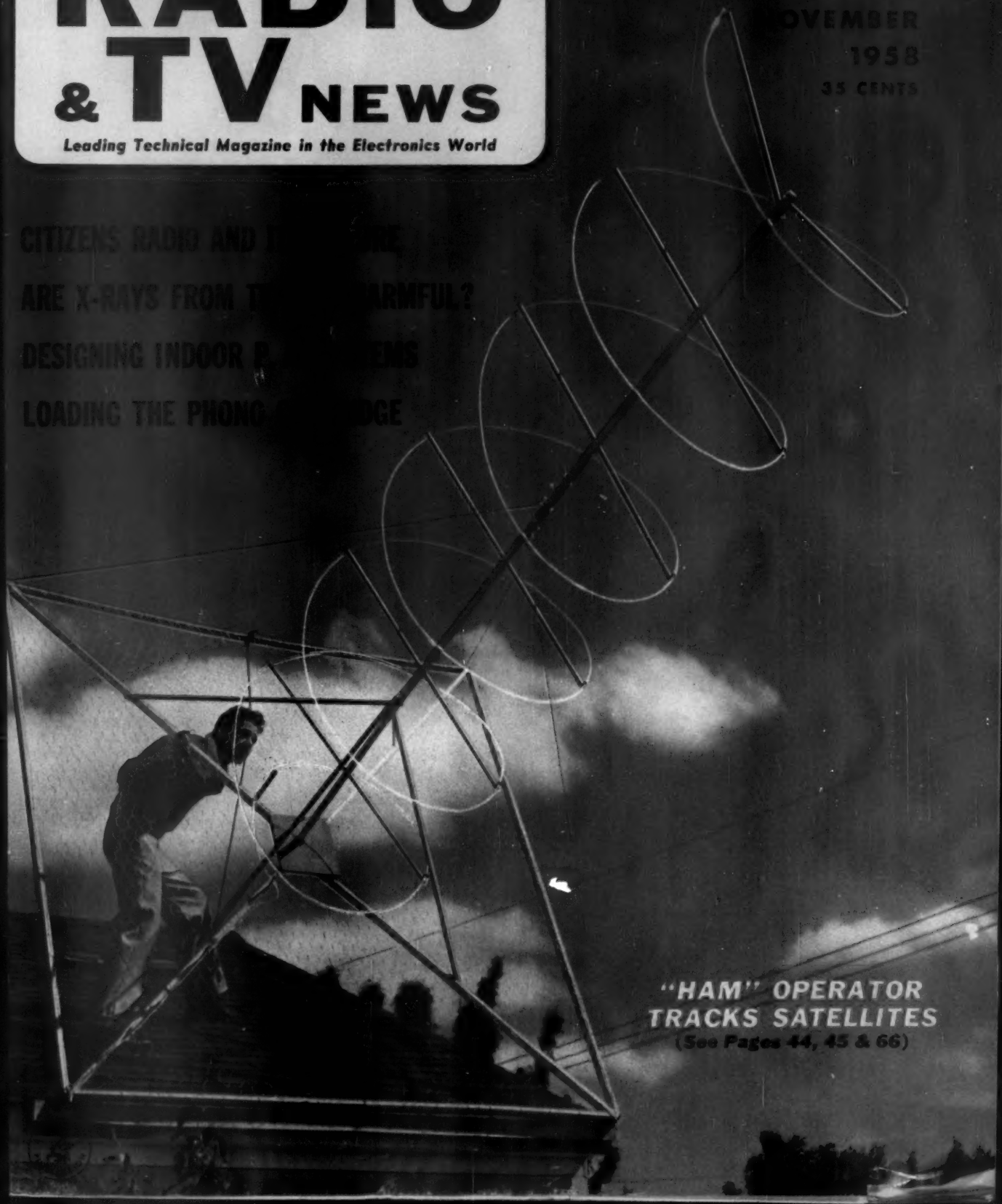

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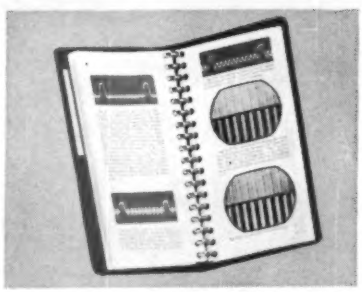

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RADIO & TV NEWS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 434 S. Wabash Ave., Chicago 5, Ill. Entered as second-class matter July 21, 1946, at the Post Office, Chicago, Ill., under the act of March 3, 1879. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. SUBSCRIPTION RATES: one year U. S. and possessions, and Canada $4.00; Pan American Union Countries $4.50; all other foreign countries $5.00.

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Editorial and Executive Offices
One Park Avenue
New York 16, N. Y. OR. 9-7200

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BRANCH OFFICES: Midwestern Office, 434 S. Wabash Ave., Chicago 5, Ill.; Western Office, Room 412, 215 W. 7th St., Los Angeles 14, Calif., John E. Payne, manager.

FOREIGN ADVERTISING REPRESENTATIVES: D. A. Goodall Ltd., London; Albert Milhado & Co., Antwerp and Dusseldorf.

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NOVEMBER, 1958 **VOL. 60 ■ NO. 5**

SUBSCRIPTION SERVICE: Forms 3579 and all subscription correspondence should be addressed to Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois. Please allow at least four weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.

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New amplifier battles "noise"

Four-stage junction diode amplifier was developed at Bell Telephone Laboratories by Rudolf Engelbrecht for military applications. Operates on the "varactor" principle, utilizing the variable capacitance of diodes. With 400-mc. signal, the gain is 10 db. over the 100-mc. band.

The tremendous possibilities of semiconductor science are again illustrated by a recent development from Bell Telephone Laboratories. The development began with research which Bell Laboratories scientists were conducting for the U. S. Army Signal Corps. The objective was to reduce the "noise" in UHF and microwave receivers and thus increase their ability to pick up weak signals.

The scientists attacked the problem by conducting a thorough study of the capabilities of semiconductor junction diodes. These studies led to the conclusion that junction diodes could be made to amplify efficiently at UHF and microwave frequencies. This was something that had never been done before. The theory indicated that such an amplifier would be exceptionally free of noise.

At Bell Laboratories, development engineers proved the point by developing a new kind of amplifier in which the active elements are junction diodes. As predicted, it is extremely low in noise and efficiently amplifies over a wide band of frequencies.

The new amplifier is now being developed for U. S. Army Ordnance radar equipment. But it has numerous other possibilities. In radio astronomy, for example, it could be used to detect weaker signals from outer space. In telephony, it offers a way to increase the distance between relay stations in line-of-sight or over-the-horizon communications.

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...for the Record

By W. STOCKLIN
Editor

BEHIND THE SCENES IN PUBLISHING

WE HAVE often wondered how many of our readers would be able to identify the abbreviations MPA and ABC or could explain the significance of the organizations thus identified. These initials designate two important organizations within the publishing field—the Magazine Publishers Association, Inc. and the Audit Bureau of Circulations. We regret that, for the most part, information on the activities of these two groups has, to a large extent, been confined to the publishing field and, in particular, to the trade journal segment of the industry.

The activities of these two groups are of vital importance to you, our readers, in that because of these organizations we are able to bring you a much better magazine—one with articles to your liking, presented attractively—all at the lowest possible cost. You, as a reader of RADIO & TV NEWS, can, to some extent, consider yourself a member of these organizations. Whenever you buy a magazine, whether it be *"Life," "Reader's Digest,"* or this publication—you participate in the multi-faceted activities of these groups.

MPA

The Magazine Publishers Association, Inc., is an organization of publishers, editors, and their circulation and advertising personnel. In this association editors and publishers can get together to discuss their mutual problems and your interests as readers. We learn such things as the effect of newspapers and TV, for example, on your magazine buying habits. We learn of changes in reader interest, not only with regard to subject but in matters of general magazine make-up. We obtain information on your reactions to two-color and even four-color art work presentations. These are only a few of the things that are studied. One of the most important functions of this organization to you as a reader is the continuous crusade being waged to uphold our constitutional guarantees as set forth in the Bill of Rights, *i.e.*, Freedom of Speech and Freedom of the Press. The organization is constantly on guard against undue censorship and the unnecessary withholding of information from the public.

Of vital importance to the association was the recent postal rate increase. This increase was actually a tremendous blow to publishers and, indirectly, to you as a reader. The MPA was active in trying to block an unreasonable increase and to some extent won its battle in that it helped to prevent an even larger increase than was finally enacted by Congress. This postal increase, although not as large as was originally projected, was like the proverbial "straw that broke the camel's back" in that it piles an additional burden on publishers over and above the ever rising cost of printing —especially in the case of magazines such as ours with large national and international distribution. The inevitable result will be an increase in the price of not only our publication, but probably all magazines in general.

ABC

The Audit Bureau of Circulations is a voluntary, non-profit association whose membership is made up of advertisers, advertising agencies, and publishers. Its function is to insure the dissemination of dependable and accurate circulation statements to media buyers.

One fact that many magazine readers tend to overlook is that without the revenue derived from loyal and consistent advertisers the price of their favorite publications would be prohibitively high. In almost every case the price paid represents only a token sum toward the actual cost of putting out the magazine. Virtually all publishers must depend on advertising revenue to support their efforts. Thus, once a year our books are opened to ABC auditors. They check our entire paid circulation and submit a report on these facts about our publication. When a company advertises in RADIO & TV NEWS it is actually paying for the opportunity of talking to people like you who buy and read our publication.

The ABC report is also our yardstick whereby we can measure how well we are serving you, our reader, because the Bureau develops important facts about our circulation. It keeps us on our toes because in order to insure your patronage year after year we must render an editorial service worthy of your loyal support. It also stimulates us to still greater effort to provide the kind of material you find most valuable—presented in the most attractive manner possible.

Your purchase of a copy of RADIO & TV NEWS is, therefore, a "vote of confidence" which, needless to say, is appreciated. The ABC report tells us that you like our publication and it also tells the advertiser that he has your interest and confidence. We are extremely

(*Continued on page* 125)

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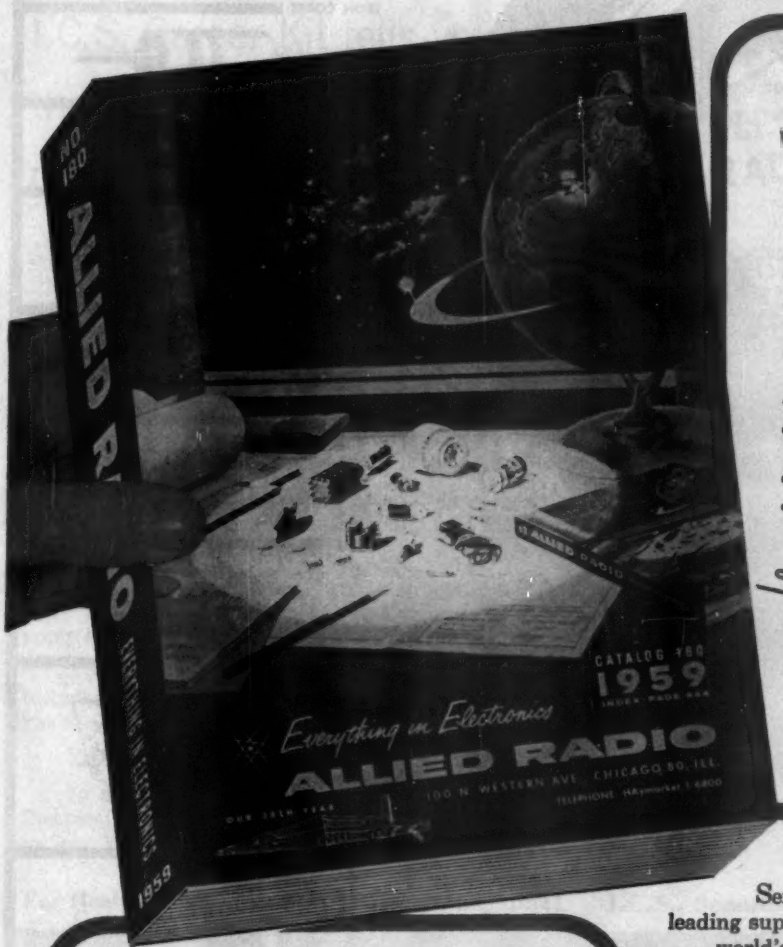

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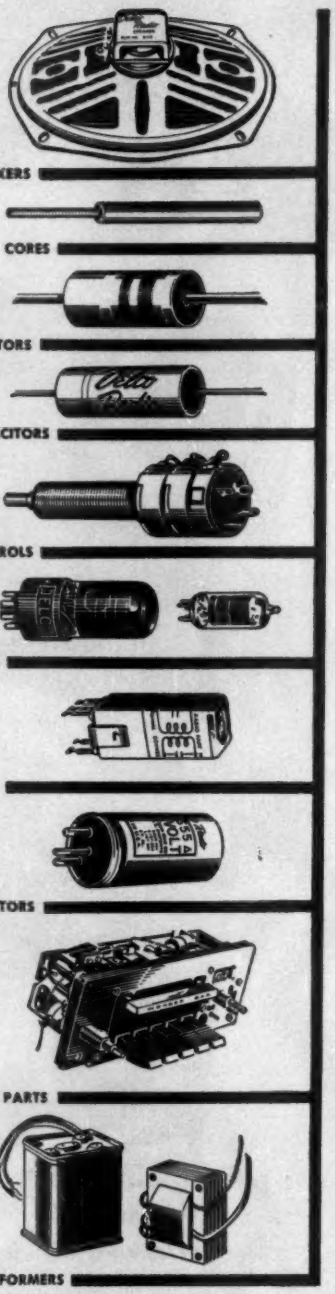

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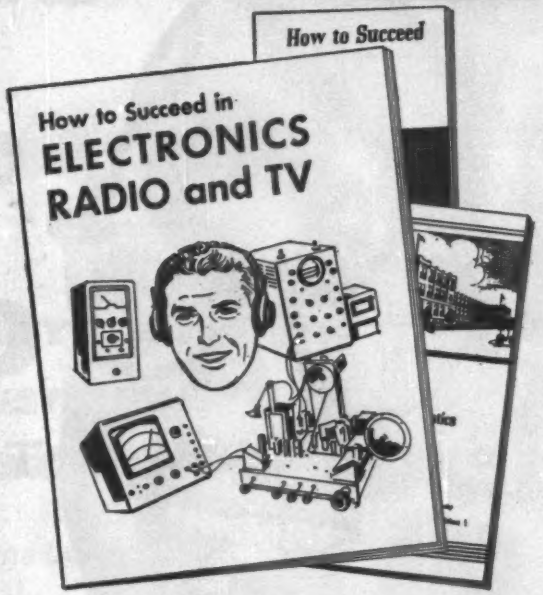

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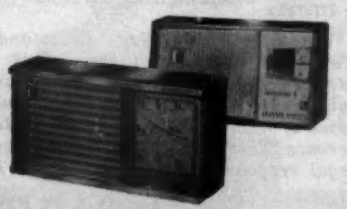

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To the Editors:

On behalf of myself and the ARTSNY, I wish to thank you for the article on our organization that appeared in the July issue. RADIO & TV NEWS is to be commended as being the first publication to devote two full pages to service industry news. The educational and instructive articles presented in your publication each month, in addition to providing ample space for service industry material, makes it easy to see why you remain a leader in the field.

There is a slight error made in our mailing address in the article. The address was given as Brooklyn 32, New York rather than Brooklyn 37, New York, which is correct. We would appreciate your bringing this to the attention of your readers.

MARTY BOXER
President, ARTSNY
Brooklyn 37, New York

Thanks to President Boxer for his comments on this publication.—Editors.

* * *

THE GREMLIN SENTRY

To the Editors:

Regarding the article on the automatic control switch described on page 49 of your June issue, I have found a few improvements that might be of interest to anyone using the circuit as a capacity relay. I am using the circuit as a burglar alarm at my home after three attempts at entry by unknown parties when we were asleep.

I have connected point *A* in Fig. 2 along with four screens and I have made the following circuit changes: Change the 1000-ohm resistor between *D* and *E* to 13,000 ohms, change R_{11} to 2500 ohms, and put a small capacitor of about .005 to .01 μfd. between point *A* and the screens. This keeps the alarm from going off in damp or rainy weather, and provides an excellently operating circuit.

E. T. MANLEY
Lucille Ave. TV
Atlanta, Georgia

We know that Reader Manley's experiences with the circuit will be of interest to many of our readers who are thinking about trying it out.—Editors.

* * *

THERMOCOUPLE-OPERATED SETS

To the Editors:

Our Principals in Eindhoven, Holland have developed a kerosene-lamp-operated radio several years ago and we take pleasure in enclosing a description of this product. No doubt, *Philips* in Eindhoven would be pleased to give you any further information you might require.

May we take this opportunity of saying how much we in New Zealand enjoy reading your magazine.

B. D. GARDEN
Philips Electrical Industries of New Zealand Limited
Wellington, New Zealand

To the Editors:

We learned from the "Readers" column of the May 1958 issue of your magazine that you are interested in learning more about the use of a thermocouple heated by a kerosene lamp to power a radio receiver or other electrical appliances.

We are one of the leading West German manufacturers, not only of television sets and export and home market radio receivers, but also of kerosene lamps, and a special department of our technical development branch here has been working for a long time on the design of such equipment, with the result that we have now gathered considerable experience in this field.

GRAETZ KOMMANDITGESELLSCHAFT
Altena (Westf.), Germany

We are still getting letters on the Russian set first mentioned in our May "Letters" column and described more fully in our August issue.—Editors.

* * *

MOBILE RADIO SERVICE

To the Editors:

On page 44 of the April issue concerning maintenance of mobile radio, Allan Lytel says, "Repairing mobile radio is more exacting than ordinary radio or television for several reasons. The technician making the required frequency checks on transmitters, by law, is responsible to the FCC for the accuracy of his work." I am a non-electronics man and an altogether too frequent user of TV and radio repair services. Am I to infer from this statement that Mr. Lytel believes that the craftsman's responsibility to me, his customer, for accuracy in his work is lessened because not regulated by law?

G. C. TENOLD, LCDR, USN
Springfield, Virginia

We are sorry that Commander Tenold misunderstood the intent of Mr. Lytel's statements. All transmitters are subject to rigid FCC regulations in order to prevent harmful interference. Therefore, the technician has a legal responsibility in addition to his

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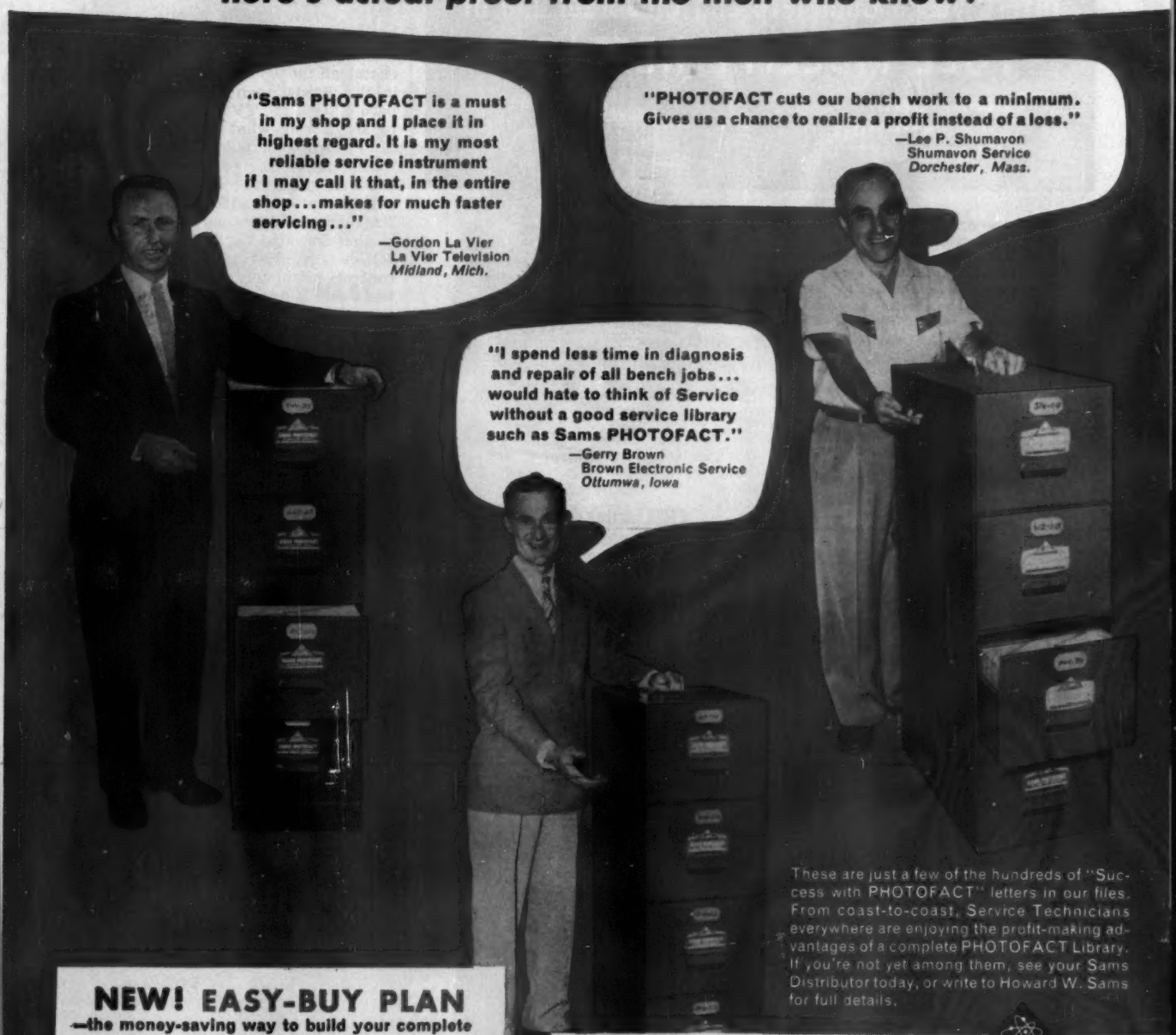

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normal responsibility to his customer. This is not to say that the technician who works strictly on receivers for consumers has any less responsibility to his customers in handling these sets, but this responsibility is not regulated by federal law.—Editors.

* * *

INVERTED VERTICAL-SYNC PULSE

To the Editors:

The article "Facts About Vertical-Sweep Circuits" in your March issue was very interesting. However, when I examined the vertical-sync pulse shown in Fig. 6, and then proceeded to compare it with my TV set, I was amazed to see a somewhat different picture. My vertical-sync pulse appeared at the top of the blanking bar and there was a gap to the left of it.

I am stationed with the Air Force in Tripoli and we are served by one TV station operated by AFRS. Here most set owners must turn their contrast controls completely down or the picture tears and is too dark. Could the position of the sync pulse in the blanking bar of our set be the cause?

M/Sgt. Joseph Gagne
APO 231, New York

We are afraid that Sgt. Gagne will have to look for some other solution to his problem of poor TV reception in Tripoli. His vertical-sync pulse is quite normal. The trouble is that our illustration is upside-down.—Editors.

* * *

WORLD'S HIGHEST TRANSMITTER?

To the Editors:

Your August issue showed a photo of an 8210-ft. Swiss TV transmitter said to be the highest in Europe, and "perhaps the world." I would like to point out that there are three TV transmitters near Albuquerque about 10,800 ft. above sea level on Sandia Crest. They are KOB-TV, KGGM-TV, and KOAT-TV.

Paul F. Bahr
Albuquerque, New Mexico

* * *

GENERATOR RANGE EXTENDER

To the Editors:

Please refer to page 43 of the June, 1958 issue of Radio & TV News ("Extend Your Signal Generator's Range"). Through a typographical error, your formula for determining the cut-off frequency (F_c) is shown the same where either a low-pass filter or high-pass filter is used.

Duane R. Andruss
Norman, Oklahoma

Obviously the formula for determining the cut-off frequency of the high-pass filter should not be identical to the one used for the low-pass filter. The printer fumbled twice on this one. We had called for a correction from him to eliminate an ambiguity in the second formula used for high-pass filters. In making this change, he dropped a diagonal line that would have indicated division. Accordingly, the formula for the cut-off frequency of a high-pass filter should be $F_c = F_\infty / \sqrt{1 - M^2}$.—*Editors.*

-30-

here's your convenient, economical way to buy dependable crystal diodes... at your CBS-Hytron distributor's now

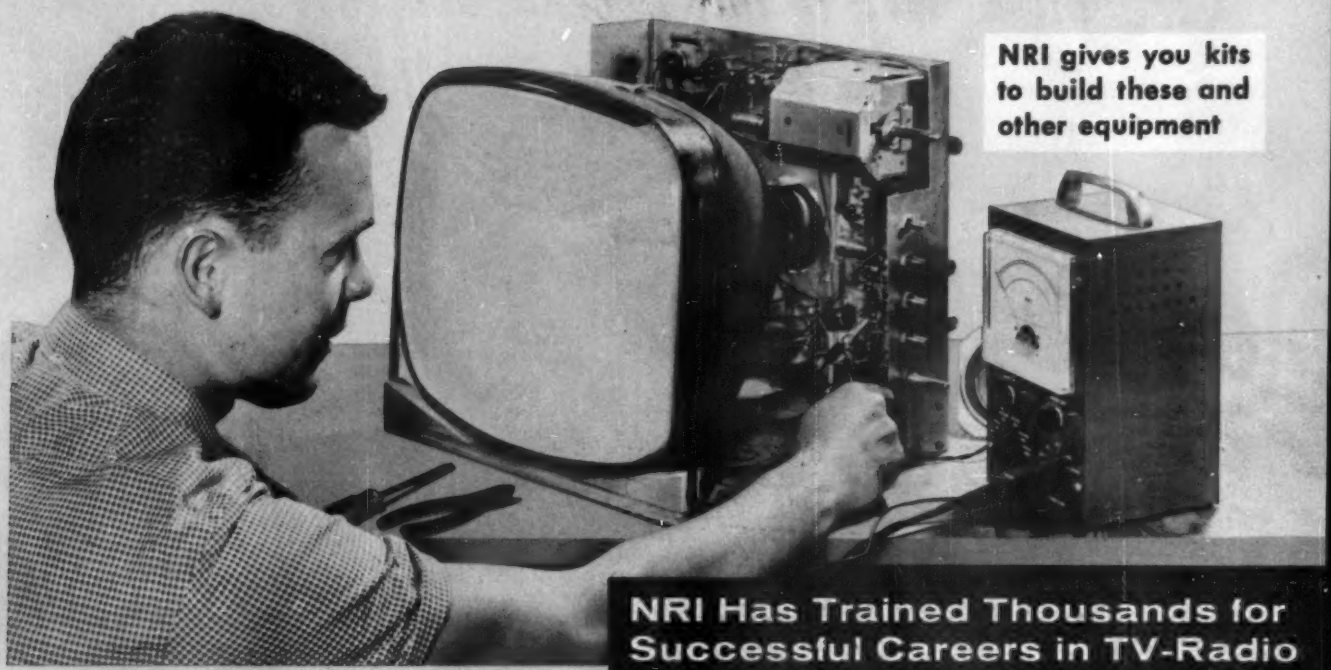
More reliable products through Advanced-Engineering

CBS-HYTRON, Danvers, Massachusetts • A Division of Columbia Broadcasting System, Inc.

Learn TELEVISION-RADIO

Servicing or Communications

by Practicing at Home in Spare Time



NRI gives you kits to build these and other equipment

Electronic Technicians Have High Pay, Prestige Jobs

People look up to and depend on the Technician, more than ever before. His opportunities are great, and are increasing. Become a Radio-Television-Electronic Technician. At home, and in your spare time, you can learn to do this interesting, satisfying work—qualify for important pay. A stream of new Electronics products is increasing the job and promotion opportunities for Television-Radio-Electronic Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the millions of Television and Radio sets now in use. The hundreds of Television and Radio stations on the air offer interesting jobs for Operators and Technicians. The military services reward qualified Technicians with higher rank and pay. Police, Aviation, Mobile Two-Way Radio are expanding. To ambitious men everywhere: here is rich promise of fascinating jobs, satisfaction and prestige, increasing personal prosperity.

Make Extra Money Soon, $10 to $15 a Week in Your Spare Time

NRI students find it practical and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Use the Tester built with parts NRI furnishes, to locate and correct Radio-TV receiver troubles. Many who start in spare time, soon build full time Television-Radio sales and service businesses; others enjoy profitable spare time businesses and the security of a source of income to fall back on in case of layoffs, hard times or other changes in regular job. Postage free card will bring you complete facts about the NRI tested way to better pay.

ACT NOW FIND OUT WHAT NRI OFFERS YOU

NRI Has Trained Thousands for Successful Careers in TV-Radio

Studio Engr., Station KATV
"I am now Studio Engineer at Television Station KATV. Before enrolling for the NRI Course, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

Has All the Work He Can Do
"Since finishing NRI Course I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Ga.

Has Good Part Time Business
"Quite early in my training I started servicing sets. Now have completely equipped shop. My NRI training is the backbone of my progress." E. A. BREDA, Tacoma, Wash.

Cut Out and Mail Postage-Free Card NOW

Sample Lesson and Catalog Both FREE

SEE OTHER SIDE

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

National Radio Institute

Dept. C D , Washington 16, D.C.

Please send me sample lesson of your Radio-Television Training and Catalog FREE. (No salesman will call.)

Name..... Age.....

Address.....

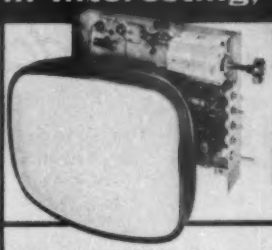
City..... Zone..... State.....

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

NRI SUPPLIES LEARN-BY-DOING KITS WITHOUT EXTRA CHARGE
Technical Know-How Pays Off in Interesting, Important Work

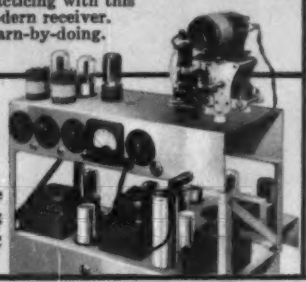
YOU BUILD AC-DC Superhet Receiver

NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.



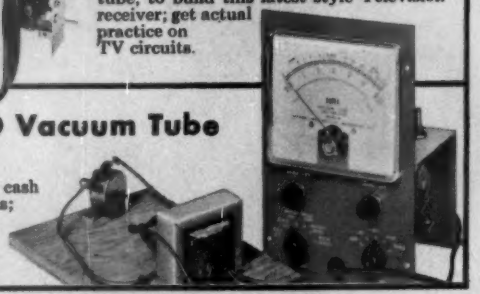
YOU BUILD This 17 Inch Television Receiver

As part of your NRI course you can get all components, tubes, including 17" picture tube, to build this latest style Television receiver; get actual practice on TV circuits.



YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.



YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

For Higher Pay, Better Jobs
Be a TV-Radio-Electronic Technician

Servicing Needs More Trained Men

Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

Train at Home the NRI Way Famous for Over 40 Years

NRI is America's oldest and largest home study Television-Radio school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with NRI Course. Clearly written, well-illustrated NRI lessons teach TV-Radio-Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

NRI Graduates Do Important Work

Now Quality Control Chief
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. Favaloro, Norwich, N. Y.

NRI Course Easy to Understand
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. Cressey, Stockton, Cal.

Works on Color-TV
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA-TV." J. F. Meline, New York, N.Y.

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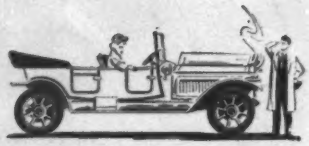
SAMPLE LESSON
64-page CATALOG
both FREE

SEE OTHER SIDE

Would you go back to the old 12 cylinder Auto?



1915 AUTOMOBILE

In 1915, the 12-cylinder engine in this automotive wonder was hailed as a great advance because it produced 95 horsepower and only weighed 800 lbs.!

1959 SPORTS COUPÉ

The engine in one of today's new 1959 sports cars delivers 300 horsepower and weighs only 660 lbs.! More than four times as efficient!

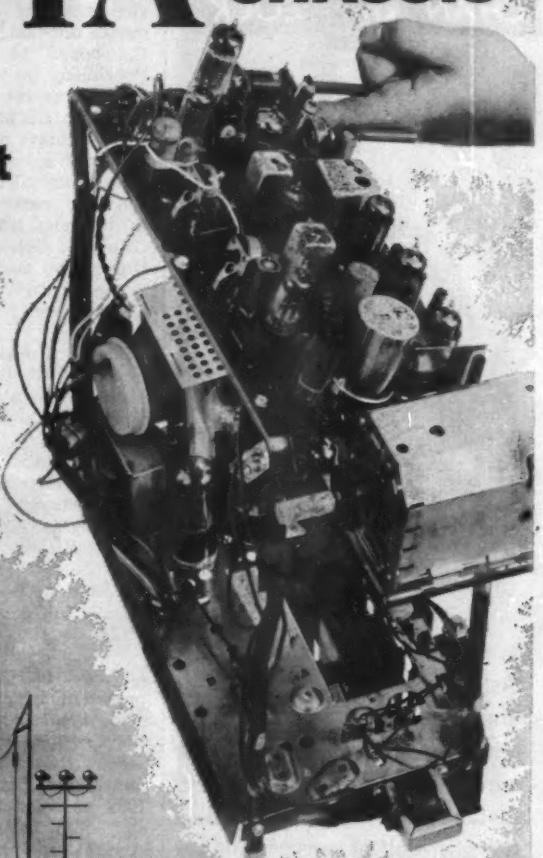
Thanks to the miracle of automation, automotive engineers have been able to pack a modern passenger car chassis with power never before thought possible for the size and weight. Sylvania has been a pioneer in applying automation to the manufacture of TV chassis, bringing more compact, better performing components.

SYLVANIA S-110 CHASSIS

the chassis modern manufacturing methods built

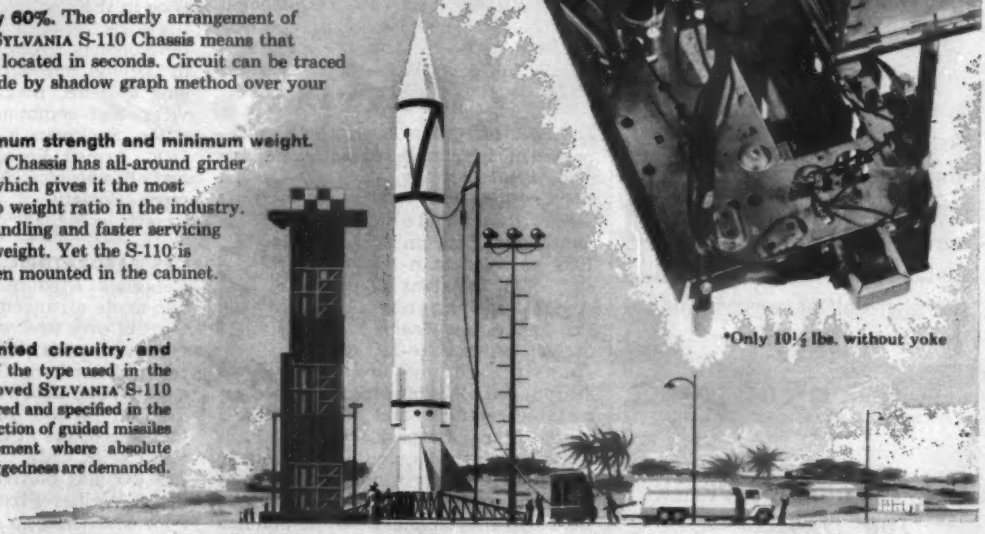
- **Better performance under the extremes of line voltage variation.** The advanced high-voltage design of the SYLVANIA S-110 Chassis adjusts automatically for maximum performance at both high- and low-voltage extremes.
- **Better performance under heat, humidity and freezing conditions.** The rigid specifications of reliability of components in the SYLVANIA S-110 Chassis assures better performance and longer trouble-free life under extremes of humidity and temperature conditions.

  Alkyd Resin used in the high-voltage socket of the S-110 Chassis withstands moisture, dirt and even frost accumulations without any permanent damage, even if these conditions are severe enough to cause arcing. Top performance is assured regardless of warehouse locations.
- **Cuts repair time by 60%.** The orderly arrangement of components in the SYLVANIA S-110 Chassis means that most defects can be located in seconds. Circuit can be traced easily from either side by shadow graph method over your bench light.
- **Designed for maximum strength and minimum weight.** The SYLVANIA S-110 Chassis has all-around girder frame construction which gives it the most favorable strength to weight ratio in the industry. This means easier handling and faster servicing because of its light weight. Yet the S-110 is sturdy and rigid when mounted in the cabinet.



*Only 10½ lbs. without yoke

Advanced printed circuitry and components of the type used in the performance-proved SYLVANIA S-110 Chassis are required and specified in the design and production of guided missiles and space equipment where absolute reliability and ruggedness are demanded.



SYLVANIA

Pioneers in modern manufacturing methods

Within the Industry

ROBERT ERICKSON has been named executive vice-president of *Beckman Instruments, Inc.*, Fullerton, Calif. He was formerly president and director of the *Heath Company* of Benton Harbor, Mich., a subsidiary of *Daystrom, Inc.*

A long-time executive within the parent organization, Mr. Erickson held the posts of vice-president of *Daystrom, Inc.*, operating vice-president of the firm's instruments division, and was a member of the board of subsidiary companies. Previously he was general plant manager of the home instruments division of *Radio Corporation of America.*

A graduate of Northeastern University with a bachelor of science degree in mechanical engineering, Mr. Erickson also received a master's degree in business administration from the Graduate School of Business, Boston University and undertook additional graduate study at M.I.T., University of Chicago, and Northwestern University.

* * *

WILLIAM S. PARSONS has been elected president of the Electronic Industry Show Corporation. He is president of *Centralab,* a division of *Globe-Union, Inc.*

Three other well-known industry leaders were also named Show Corporation officers for one-year terms. They are: William H. Thomas, president of *James B. Lansing Sound, Inc.*, elected vice-president; Morris Green, president of *Almo Radio Company,* elected secretary; and Karl W. Jensen, president of *Jensen Industries,* named treasurer.

* * *

J. T. CATALDO has been named vice-president in charge of sales for *International Rectifier Corporation.*

Mr. Cataldo joined the firm in 1952 as sales manager and assistant general manager. Previously he was project advisor responsible for research and development activities on metallic rectifiers and other products at the Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey.

He holds engineering degrees from Clarkson College of Technology and Brooklyn Polytechnic Institute and has done graduate work at B.P.I. and Rutgers University. Mr. Cataldo is a member of the IRE, has authored more than sixty papers on theory and applications of metallic rectifiers, and now holds several patents pertinent to this field.

* * *

ELECTRONIC INDUSTRY SHOW CORPORATION has announced committee appointments for its 1959 show to be held in Chicago.

Committee chairmen are as follows: Mrs. Helen Quam, *Quam-Nichols Co.*, entertainment; Morris Green, *Almo Radio Co.*, housing; Lew W. Howard, *Triad Transformer Corp.*, publicity; Sidney Harman, *Harman-Kardon, Inc.*, educational and program; Rubin Green, *Green Tele-Radio Distributors Inc.*, credentials; William H. Thomas, *James B. Lansing Sound, Inc.*, space and arrangements; and Karl W. Jensen, *Jensen Industries,* finance.

* * *

ROBERT SACKMAN, vice-president and general manager of *Ampex Corporation,* has been named to the board of directors of *ORRadio Industries, Inc.*

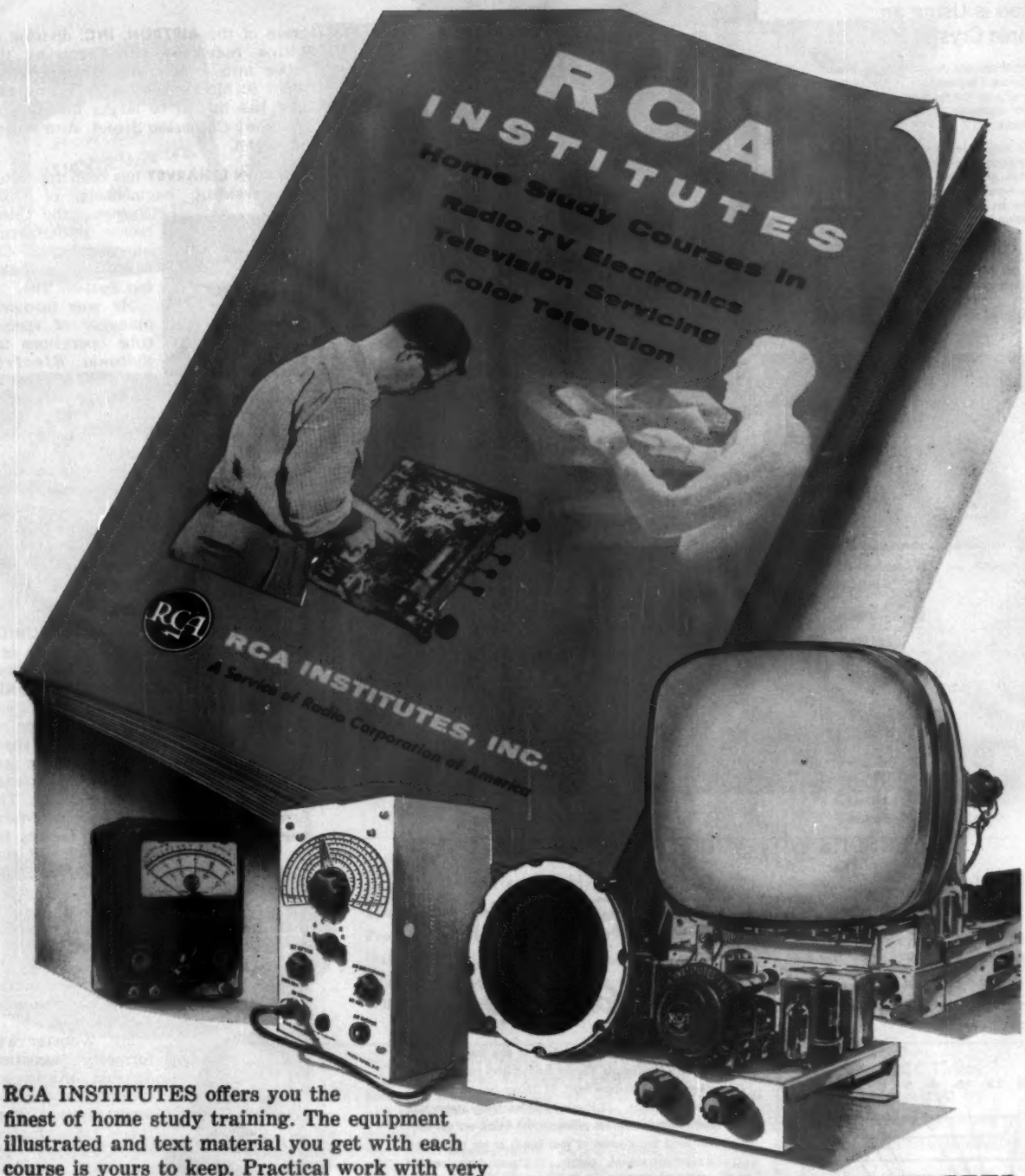
Mr. Sackman has been with the magnetic recording equipment manufacturing firm since 1953 and was successively manager of the company's Washington, D. C. district office and vice-president and manager of the instrumentation division prior to his present position.

He has had over twenty years of engineering and management experience in the electronics industry including director of a large research and development group in the Department of Defense, specializing in data processing systems, magnetic recording devices, and communication equipment.

Mr. Sackman is a member of the IRE, Armed Forces Communications and Electronics Association, Instrument Society of America, and the American Management Association.

* * *

CBS LABORATORIES, a division of the *Columbia Broadcasting System, Inc.*, has made arrangements to purchase a tract of over twelve acres adjoining the eleven acre site of its new research center in Stamford, Conn. . . . **EITEL-McCULLOUGH, INC.** has established a new location for the firm's executive and business offices at 301 Industrial Road, San Carlos, Calif. . . . **GYRO ELECTRONICS CO.** has moved to larger quarters at 36 Walker Street, New York City . . . The Chicago offices of **INTERNATIONAL WIRE & CABLE COMPANY** are now situated at 1665 North Milwaukee Avenue . . . Expansion of the ferrite development and manufacturing pro-



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RESIDENT SCHOOL courses in New York City offer comprehensive training in Television and Electronics. Day and evening classes start four times each year.
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To save time, paste coupon on postcard.

gram of the **AIRTRON, INC.** division of *Litton Industries* has begun by the move into a new 100,000-square-foot plant in Morris Plains, N. J. . . . **VOKAR** has moved to larger quarters at 201 East Catherine Street, Ann Arbor, Michigan.

• • •

NORMAN L. HARVEY has been appointed vice-president, engineering, of *CBS-Hytron*, the electronic manufacturing division of *Columbia Broadcasting System, Inc.*

He was formerly manager of special tube operations for *Sylvania Electric Products Inc.* in Williamsport, Pennsylvania. Mr. Harvey joined the firm in 1941 as a research engineer and successive promotions led to his appointment as head of the applied research branch in 1948. In 1950 he was named chief engineer of the radio and TV division and was given his most recent assignment in 1956.

Mr. Harvey is a graduate of Iowa State College and is a fellow of the IRE.

• • •

ACOUSTICA ASSOCIATES, INC. has acquired **THE GENERAL ULTRASONICS COMPANY.** The latter will operate as a wholly owned subsidiary of the parent company . . . **KENYON ELECTRONIC SUPPLY CO.** is the new name of *Kenyon Radio Supply Co.* There has been no change in ownership, officers, or management . . . **RCA** has acquired the production plant of the *Applied Science Corporation* of Princeton, N. J. The firm will use the plant as a long-term engineering and production facility for its Astro-Electronic products division . . . A new company, **CERAMICS FOR INDUSTRY CORP. (CFI),** has been formed. Located at Mineola, New York, the firm manufactures a variety of precision ceramic parts and composites.

• • •

DANIEL J. WEBSTER has been named general sales manager of *Tung-Sol Electric Inc.*

Mr. Webster was formerly assistant division manager, commercial equipment division, *Raytheon Manufacturing Company.* He also held executive posts with *Westinghouse* and *Murray Manufacturing Corp.*

In his new position Mr. Webster will direct the firm's field sales activities, including electronic and automotive original equipment, distributor, export, and government sales.

• • •

ELECTRONIC INDUSTRIES ASSOCIATION has elected members of the Organization Committee for the fiscal year 1958-59.

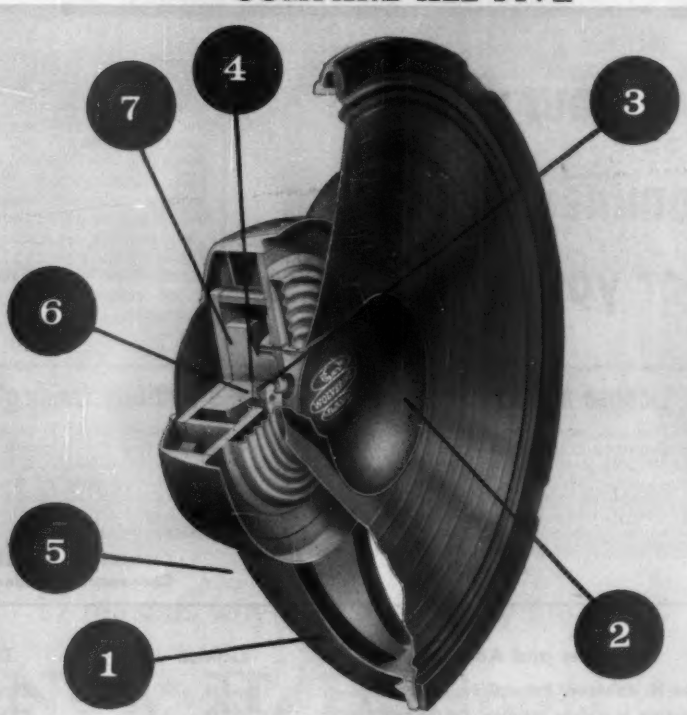
Paul V. Galvin, board chairman of *Motorola Inc.* was named chairman. Other members are: Max F. Balcom,

(*Continued on page* 96)

NEW WOLVERINE

series by Electro-Voice®

COMPARE ALL FIVE

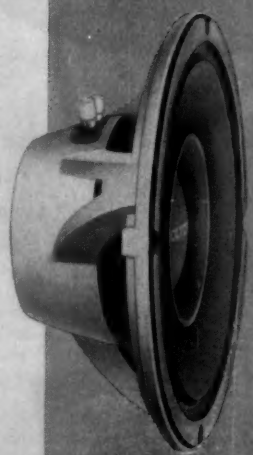


		WOLVERINE LS-12 and LS-8	SPEAKER A	SPEAKER B	SPEAKER C	SPEAKER D
1	Die Cast Frame	Yes	No	No	No	Yes
2	Radax Cone	Yes	No	No	Yes	No
3	Edgewise Wound Voice Coil	Yes	No	No	No	Yes
4	Glass Coil Form	Yes	No	No	No	No
5	Low Silhouette Frame	Yes	No	No	No	Yes
6	Long Throw Voice Coil	Yes	Yes	Yes	Yes	No
7	Slug Type Magnet	Yes	Yes	Yes	No	Yes
	NET PRICE	LS-12 $19.50 LS-8 $18.00	$23.75	$19.50	$33.00	$59.40

SELECT SPEAKER

LS-12 12" Full-Range Loudspeaker **$19.50**

LS-8 8" Full-Range Loudspeaker **$18.00**



Visit your Electro-Voice dealer. Compare the Wolverine system. Whether you're starting from scratch or converting to stereo, Wolverine components will suit your taste . . . meet your budget.

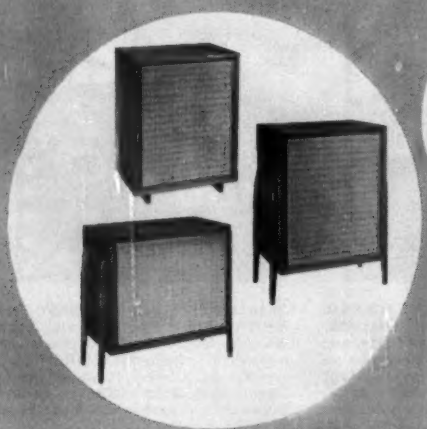
Write for complete Wolverine brochure.

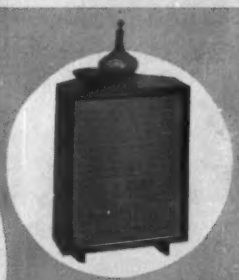
popular-priced components for true high fidelity and superb stereo!
Look at the Wolverine feature chart

Compare the Wolverine Series' quality features with *any* high fidelity speaker or enclosure. And, compare the PRICE! You can actually get a complete stereo system at the price of a single monaural system.

Only Electro-Voice with its corps of 60 engineering personnel and vast precision manufacturing facilities can give you so much more value.

CHOOSE FROM THREE MAGNIFICENT AUDIO-ENGINEERED ENCLOSURES





LORAINE
Direct radiator, folded-horn corner enclosure for 12-inch speakers plus Step-Up Kits. Overall size: 27" high x 20" wide x 14" deep. **$48.00**

LANCASTER
Direct radiator, along-the-wall, controlled baffle, for 12-inch speakers plus Step-Up Kits . . . note flexibility for horizontal or vertical use. Overall size: 25" high x 20" wide x 14" deep. **$48.00**

Model LK1 Accessory Legs **$8.00**

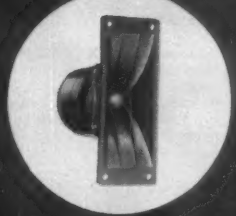
The Lancaster, Loraine, and Lindon are finished in Blonde, Mahogany, or Walnut.

LINDON
Direct radiator, shelf-type enclosure for 8-inch speakers and 2-way separate speaker systems. Overall size: 11" high x 23½" wide x 10" deep. **$34.50**

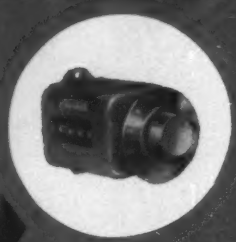
Lindon also available ready-to-finish. **$29.00**

Step up your system with Wolverine treble or high frequency kits.

THEN ADD — MF-1 STEP-UP KIT



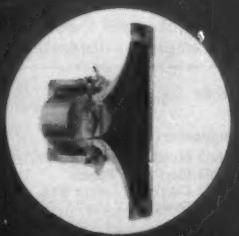
LATER ADD — MF-1 STEP-UP KIT



Gives your complete 2-way speaker system with increased output in vital "presence" range and smooth, peak-free response. Use with Loraine and Lancaster.

Includes MB-10 treble driver and CF-10 crossover network.

$25.00



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FOREMOST IN ELECTRO-ACOUSTICS—Microphones, Phono-Cartridges, High-Fidelity Loudspeakers and Enclosures, Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.

ELECTRO-VOICE, INC. BUCHANAN, MICHIGAN

All-purpose "SCOTCH" BRAND Magnetic Tape No. 111. Flawless sound reproduction at low cost. Has acetate backing and exclusive built-in dry lubrication. Recommended for all general recording needs. The international standard of recording industry.

Long-playing "SCOTCH" BRAND Extra Play Magnetic Tape No. 190. 50% more tape on a standard-size reel. Gives you as much recording time as 1½ reels of standard tape–plus brilliant sound, from new high-potency oxide. You enjoy freedom from reel change.

Weather-balanced "SCOTCH" BRAND Extra Play Magnetic Tape No. 150. Made for use in extremes of temperature and humidity. Ideal for all-weather outdoor recording. 50% extra playing time. Super-potent oxide produces uniform response, crisper tones.

Low Print "SCOTCH" BRAND Magnetic Tape 131. Reduces print-through to a point below noise level on most professional machines . . . in fact, 8 db lower print level than conventional tapes. Has excellent recording characteristics.

Tensilized 200 "SCOTCH" BRAND Magnetic Tape. The original no-break, no-stretch tape that plays twice as long . . . double strength, and double length. You get as much recording time as with two reels of conventional tape.

New Quick-Load Cartridge! Fits new quick-load cartridge machines. Records both monaural and stereo sound. Eliminates threading, rewinding, spare reels. Convenient, pocket size is ideal for easy storage in home tape libraries.

Send coupon for full details

If your dealer does not stock these new items, send for complete information.

3M Company, Dept. A-6789
St. Paul 6, Minn.

Rush me detailed information on:

- ☐ "SCOTCH" BRAND Quick-Load Tape Cartridge
- ☐ "SCOTCH" BRAND Magnetic Tapes
- ☐ "SCOTCH" BRAND Plastic Storage Box
- ☐ "SCOTCH" BRAND Splicing Tape

Name_____

Address_____

City_____ Zone____ State_____

My Dealer's Name_____

MINNESOTA MINING AND MANUFACTURING COMPANY

3M COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

There's something for everyone in the great new "SCOTCH" BRAND line!

NEW Package Designs!

Fresh, bright, colorful new designs for instant identification of "SCOTCH" BRAND Magnetic Tapes! Look for your favorite in its brand new package!

High-fidelity "SCOTCH" BRAND High Output Magnetic Tape No. 120. With this tape you enjoy music with greater dynamic range, freedom from distortion on signal peaks and 133% more output for brilliant sound reproduction. A must for all high-fidelity fans.

Super-strong "SCOTCH" BRAND Magnetic Tapes Nos. 102 (formerly 111 AM) and 122 (formerly 129 AM). Coated on weather-balanced 1½ mil polyester backing, these are the toughest tapes made. Their superb recording characteristics are similar to Nos. 111 and 120. Ideal for long term storage of your valuable, irreplaceable recordings.

New Plastic Storage Box! Tight-sealed, moisture protected storage container of unbreakable plastic. Maintains ideal storage conditions for your valuable tape recordings. One of the most practical accessory items you can buy!

"SCOTCH" BRAND Splicing Tape has a special white thermosetting adhesive that is guaranteed not to ooze. Makes splices that actually strengthen with age. Available in handy blister-pac display card at your tape dealer's now.

Look for them all at your dealer's "SCOTCH" BRAND TAPE CENTER!

You can't miss the inviting new "Plaid Pole" with its bright plaid design, convenient banks of "SCOTCH" BRAND Magnetic Tapes and, new Quick-Load Cartridges. Everything you need for high-quality tape recording is yours in the "Tape Center."

REG. U. S. PAT. OFF.

SCOTCH BRAND Magnetic Tapes

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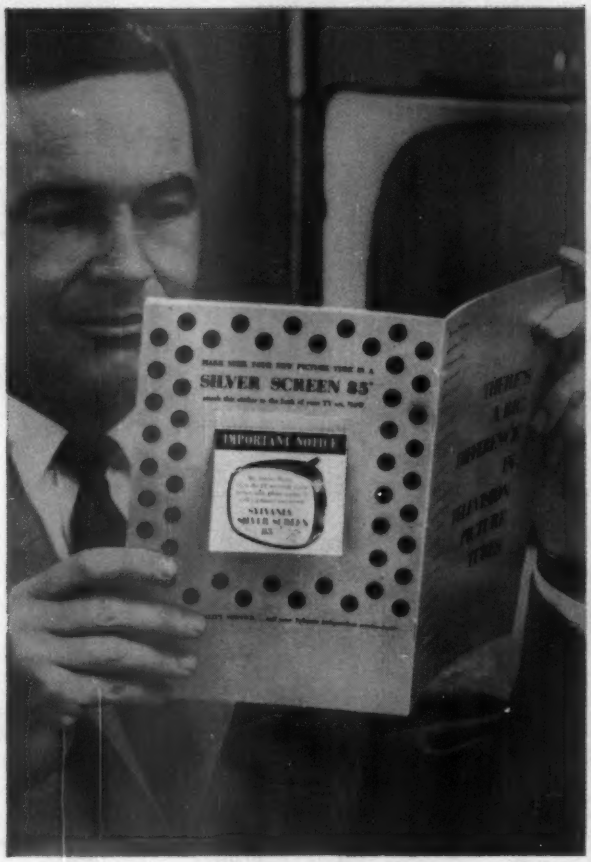

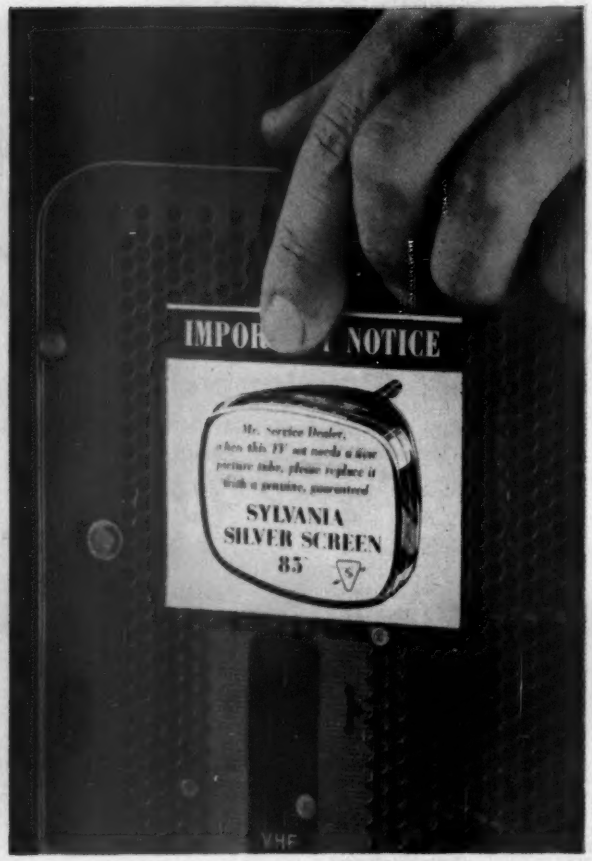

This label is your signal that a value-minded customer has been sold up to Silver Screen 85.

New consumer booklet from Sylvania helps you

SELL UP TO SILVER SCREEN 85

Free booklet tells the story of Silver Screen 85's superior performance—detachable sticker lets the consumer tell you he's *presold* on Silver Screen 85

Leave a copy on every service call or make a complete mailing to your customers and prospects. Either way, Sylvania's new booklet, "There's A Big Difference In Television Picture Tubes," can help you sell up to more profits through more Silver Screen 85 sales.

In layman's language, this booklet details the difference between Silver Screen 85 and cut-rate off-brand tubes. It's chock-full of facts as they were revealed in Sylvania's recent test of a nationwide sample. What's more, there's a handy sticker on the back of each booklet for the customer to attach to the back of his TV set. This is your signal that he's *presold up* to Silver Screen 85.

Get on the bandwagon. Let Sylvania help you sell up. Give each of your customers and prospects a copy of this new booklet. It's available free, complete with mailing envelope, from your Sylvania Distributor. Or write for a sample copy.

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MVS2-24 GRIFF WILLIAMS SOCIETY ORCH. Let's Fly Away, Dance Medley, The Petite Waltz, I Know That You Know, When Day Is Done, The Girl Friend. Reg. $7.95.

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MDS2-4 MUSIC FROM THE BIG TOP. Carl Stevens & Circus Band. William Tell Gallop, Mosquito Parade, The Thunderer, Asleep in the Deep, El Capitan, Dance of the Snake Charmer, Colonel Bogey, Muskrat Ramble, Fairest of the Fair, Bombasto, Invincible Eagle, Anchors Aweigh, Marines' Hymn, U.S. Air Force March, Semper Paratus, West Point March. Reg. $12.95.

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MDS5-1 HARRY JANOS SUITE (KODALY). Antal Dorati & Minneapolis Sym. Orch., in astounding hi-fi. Reg. $12.95.

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MBS5-19 IBERIA (ALBENIZ). Minneapolis Sym. Orch., Dorati cond. Reg. $10.95.

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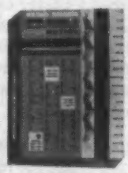

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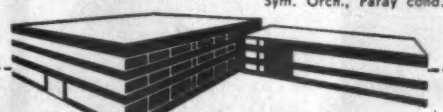

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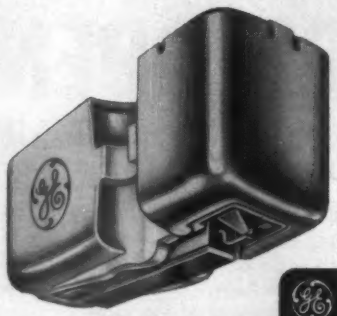
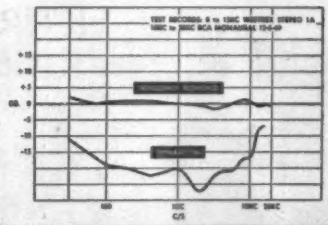
1 New "Golden Classic" stereo-magnetic cartridge



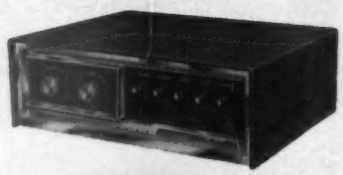
• Plays both stereo and monaural records • Full frequency response, 20 through 20,000 cycles • "Floating armature" design increases compliance and reduces record wear. Effective mass of stylus approximately 2 milligrams • High compliance in all directions—lateral compliance 4 x 10^{-6} cm/dyne; vertical compliance 2.5 x 10^{-6} cm/dyne • Recommended tracking force with professional-type tone arm 2 to 4 grams • Consistently high separation between channel signals. (Specifications for Model GC-5.)



Model GC-7 (shown left) with .7 mil diamond stylus....$23.95*
Model GC-5 (for professional - type tone arms) with .5 mil diamond stylus....$26.95*
Model CL-7 with .7 mil synthetic sapphire stylus.....$16.95*

• A professional-type arm designed for use with G-E stereo cartridges as an integrated pickup system • Features unusual two-step adjustment for precise setting of tracking force from 0 to 6 grams • Lightweight brushed aluminum construction minimizes inertia; statically balanced for minimum friction, reduced stylus and record wear. $29.95*

2 New "Stereo Classic" tone arm

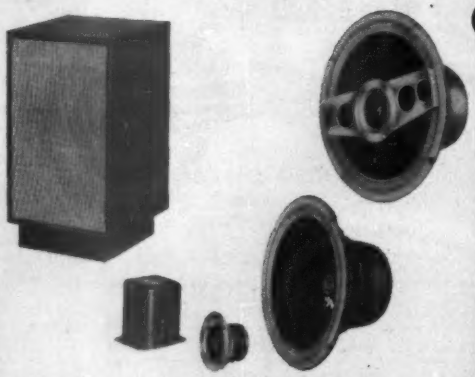


New 40-watt "Stereo Classic" amplifier

• Full, balanced 20-watt power output from each channel at same time • Flat response within 0.5 db from 20 to 20,000 cycles • Outstanding sensitivity, extremely low hum and noise level • Integrated single-knob controls for easy simultaneous adjustments of both stereo channels. Contour control provides smooth, gradual bass boost without apparent change in sound intensity. $169.95*

New FM-AM tuner

• Receives weak signals with unusually low distortion, hum and noise level • No audible drift • Visual meter provides center channel tuning of FM and maximum AM signal • RF amplifier stage in both FM and AM increases sensitivity • FM multiplex jack for stereo adaptor. $129.95*



5 New "Stereo Classic" speaker systems

• New Extended Bass system produces 4 times the undistorted power at low frequencies (+6db) as standard 12" speakers in the same enclosure • Amplifiers of only moderate power needed because efficiency is 2 to 4 times higher than comparable systems • New direct radiator tweeter provides unusually smooth response and exceptional sound dispersion at higher frequencies without unnatural tone coloration.

Model LK-12: Separate woofer-tweeter kit with crossover network $89.95*
Model LC-12: Same basic woofer with tweeter coaxially mounted in front and crossover network $89.95*
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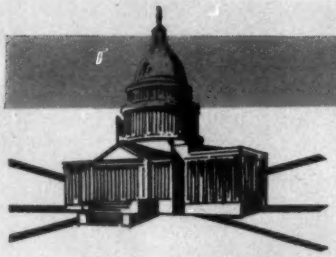
Hear G-E "Stereo Classic" components at your dealer. For more information and nearest dealer's name, write General Electric Company, Dept. RT118, W. Genesee St., Auburn, N. Y.
*Mfr's. suggested resale prices.

GENERAL ELECTRIC



Latest Information on the Electronic Industry

Spot News

By RADIO & TV NEWS' WASHINGTON EDITOR

SATELLITES TO AID FUTURE WEATHER MEN—Electronic forecasting using satellites will soon be employed to obtain and transmit data concerning cloud cover, storm patterns, radiation values, meteorological dust concentrations, ozone layers, and other space information of value in weather research, according to the Office of Meteorological Research in the Weather Bureau in Washington. Satellites are expected to include television devices to view the earth from hundreds of miles up as they orbit the earth many times a day. Forecasters who now make predictions of the weather up to five days ahead have long wanted, for example, a continuous and enlarged "moon's-eye" view of the ever-changing storm patterns around the entire globe, and especially over those marine and polar areas where few observations are available.

RADAR NOW KEY STORM FORECAST TOOL—Meteorologists are today enthusiastic about the bright prospects raised by new radar equipment in bringing new knowledge of precipitation processes and local variation in heavy rainstorms. Later this year the Weather Bureau will begin the installation of newly designed weather search radar equipment that will give severe-storm forecasters more of the detailed three-dimensional data they need to follow rapidly changing developments in advancing rain areas, squall lines, thunderstorms, hailstorms, and tornados. A network of 31 search radar stations will be established to warn of severe storms and alert the public to possible flash floods.

CAA AND AIR DEFENSE TO USE JOINTLY MILITARY RADAR FOR AIR TRAFFIC—An extensive program for the joint use of civil and military radar in air-traffic control has been completed by the Civil Aeronautics Administration and the U.S. Air Force Air Defense Command and is expected to be put into effect some time this Fall. Thirty-one new high-power, long-range radars will be used for control operation. This joint use program represents a savings of many millions of dollars in equipment, installation, and recurring maintenance costs. Serious radar interference problems have been avoided and improved coordination developed in the missions of these agencies through their joint actions in the program.

NEARLY $1-MILLION OK'ED FOR NEW TV TRANSLATORS—The translator—a blueprint plan only a short while ago—has blossomed into a million-dollar operation; that much has been and will be budgeted for 169 translators that have been and will be installed in 100 areas covering 140 communities. As of late summer, there were 125 translators in operation. Average costs for a 1-channel translator is about $6000; 2-channel units are priced at about $13,000; 3-channel systems cost about $20,000.

TV BROADCAST INCOME REACHES NEW PEAK—Total television broadcast revenues during 1957 were $943.2 million or 5.2 per-cent above the 1956 figures. Industry profits (before Federal Income Tax) amounted to $160 million. The foregoing income covered u.h.f. and v.h.f. income, however, the "U" stations suffered a loss, their revenue (for 88 stations) dropped from $32.5 million to $26.7 million for a loss of $3.5 million, as compared to a 1956 loss of $1.9 million when 95 stations were on the air.

RADAR TO SHINE IN $175-MILLION AIR-TRAFFIC CONTROL PROGRAM—The fiscal 1959 air-navigation facility program, based on an appropriation of $175 million—the largest of its kind in the history of the CAA—places great emphasis on the use of radar for all types of traffic control. Plans call for a total of 19 airport surveillance radars (ASR) to be installed at CAA control towers and 10 of the towers to be equipped with airport surface detection equipment (ASDE).

NAVY AWARDS MILLION-DOLLAR RADIO CONTRACTS TO INDUSTRY—The Navy has announced award of contracts totalling $22 million to Westinghouse for the production of ship-board radio transmitters and radars. One contract, worth more than $8 million, calls for the manufacture of an advanced air-search radar for cruisers, aircraft carriers, and other surface ships. Another contract, for more than $12 million, covers transmitters for surface and submarine service. -30-

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George Tally is one of the Hughes Field Engineers assigned to an Air Force base in California. He is highly respected, for, to the personnel of this base, he represents all the technical knowledge of the Hughes Aircraft Company.

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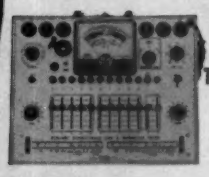


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

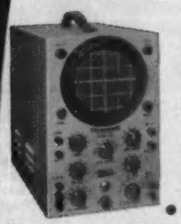
COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication of Gm, Gp & peak emission. Simultaneous sel** of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons:** rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**

NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **incremeter** for excellent linearity. **Extremely flat** RF output; **new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in 5 fund. bands. **Variable Marker Range** 2-75 mc in 3 fund. bands; 60-225 mc on harmonic band. 4.5 mc Xtal Marker Osc., xtal supplied. Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.



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• **Features DC Amplifiers!**

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **throout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **pre-set TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

5" PUSH-PULL Oscilloscope #425: Kit $44.95, Wired $79.95.
7" PUSH-PULL Oscilloscope #470: Kit $79.95, Wired $129.50.

New!

Series/Parallel R-C COMBINATION BOX #1140

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Wired $49.95

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Pix Tube Test Adapter $4.50

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WIRED $38.95
Extra-filtered for transistor equipt.
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WIRED $28.95

20,000 Ohms/Volt V-O-M #565
KIT 24.95
Wired $29.95

1000 Ohms/Volt V-O-M #536
KIT $12.90
Wired $14.90

Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd, power factor.

KIT $19.95
Wired $29.95

R-C BRIDGE & R-C-L COMPARATOR #950B

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower** for improved mod. **Variable depth of int. mod. 0-50%** by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't burn-out circuit. 7 **non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.

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SCOPE PROBES		
Demodulator	$3.75	$5.75
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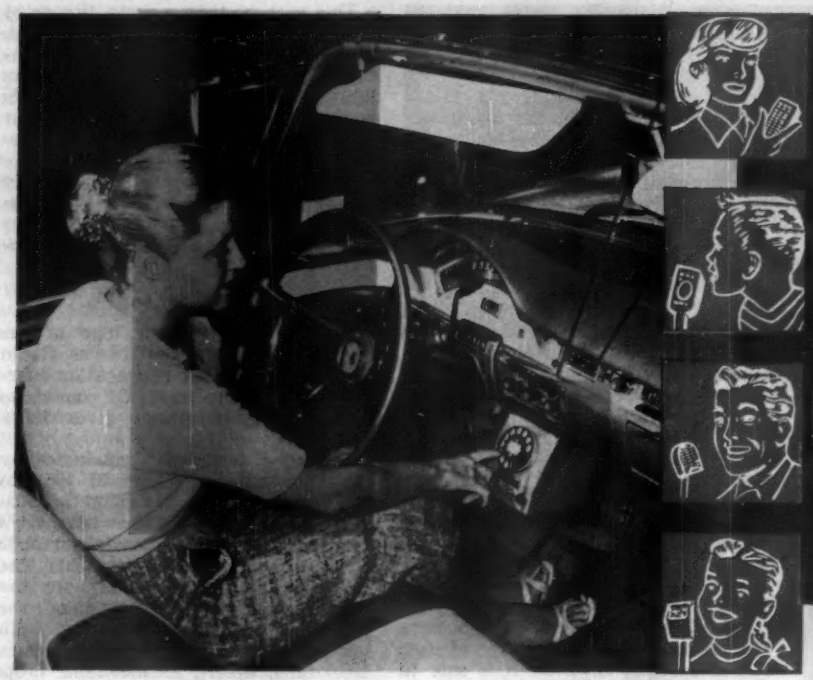
Address .....

City ..... Zone ..... State .....



Citizens Radio Faces the Future

By
HAROLD B. McKAY

Interference on Citizens Band frequencies may be minimized by the use of code selective devices like the Secode control unit that is shown in operation here.

What's happening to radiotelephony in the 460-470 mc. band? Here's an informative and interesting summary.

CITIZENS Radio was born in the immediate post-war era in a climate which was supposed to be favorable to the common man. The reasons for creating the Citizens Service were partly altruistic. Some of the commissioners on the FCC at the time felt that the plain ordinary citizen should be allowed to have a radio transmitter if he wanted it—not because he owned a business or was part of a corporation, not because he was a policeman, fireman, or doctor—but simply because he wanted a radio to use. The "Buck Rogers," push-button age thinking helped foster these views.

The motives probably included some selfish aspects. The FCC had been constantly bombarded by demands for radio licenses by businesses which did not qualify under rules existing at the time. This motive still exists; there are many needs for radio, in delivery vehicles, on farms, and in small business. The Citizens Band has been a convenient catch-all for these groups.

At the time the band was first opened for experimental use, little was known of communication techniques in the 400 to 500 megacycle band. Amateurs operating on 420 megacycles had to use tubes and components designed for other services and which produced poor results at this frequency.

A few experimenters pioneered the Citizens Band and found out that transmission was a fickle thing. The tiny amounts of power which were generated capriciously faded out even when the two stations were in sight of each other, yet at other times boomed in loudly behind hills and in between buildings as multiple reflections tossed the signal around.

Even with the commercially built equipment which followed later, this difficulty hampered acceptance of the service. *Stewart-Warner* made the "Portaphone," a self-contained radio transmitter and receiver in a telephone handset. The transmitter consisted of an oscillator tube and a modulator, with a printed circuit tuner which held to the required frequency tolerance. The same two tubes functioned as a superregenerative receiver when listening.

Stewart-Warner ultimately abandoned production on this item because of the erratic behavior, not of the equipment, but of the band itself. For instance, communication was possible between different floors of a steel and concrete building, yet failed over short distances of open street where the users were within hailing distance. While this performance would be acceptable to amateurs or other experimenters, the citizen for whom the service was created expected more; he wanted the sets to work like his telephone. He expected to be able to pick up the handset and talk—at any time or place.

A further difficulty from the user's viewpoint was that the superregenerative receiver in these units required tuning or "hunting" for the transmitted signal, and might require re-adjustment during use. This, of course, is characteristic of this type of circuit and is a necessary evil in an instrument small enough to be hand-held.

This, then, was the common man's radio, the Class B Citizens Service. It had a broad band centered on 465 mc. and relatively simple circuitry would suffice. The Class A Citizens Service which included the upper and lower frequencies in the 460-470 mc. band, required a much closer frequency tolerance. As equipment was developed, this became the area of crystal-controlled mobile units, costing hundreds of dollars. The limitations of the Class B service with its low power (150 mw. in the "Portaphone") were overcome by using elevated antennas and pouring on more power, the classic remedy for all radio service. The prospective user of Class B couldn't afford all this, so little has been done to expand this type of service.

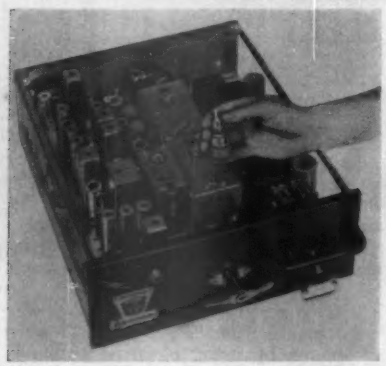
Still manufactured and still popular with radio-minded people is the *Vocaline*, a compact 3-tube transceiver which can be operated anywhere that 117 volts a.c. or 6 volts d.c. power is available.

Band Shortage & Rule Changes

As in the case of the various amateur bands, once a few brave souls had pioneered the Citizens Service and found that it could be made to work for farm vehicles and delivery trucks, those who bet only on sure things began to covet the band. Citizens Radio rules had a provision that applications would not be accepted from those who could qualify for other services.

General Electric's desk-top Citizens Radio station is housed in a mobile-type case that will front-mount under auto dashboards or under truck seats.

The Kaar TR 500 is a medium-powered transmitter and receiver. Final amp is pair of Amperex 6939's, 12 w. input.



Motorola's mobile unit has an r.f. power output of over 18 w. and uses two 2C39A's in tuned cavity circuits as tripler-driver and final amplifier.

But soon the industrial, taxicab, telephone, and other services began to overflow their assigned bands and the little-used Citizens Band looked tempting. First attempts to get a re-assignment came from the telephone companies whose expanding businesses needed more frequencies for services to inaccessible spots, two-way mobile, and microwave.

Next, groups like the National Association of Manufacturers' Radio Committee and the American Trucking Association expressed interest in the band.

One of the big demands for re-allocation of the Citizens Band has been from businesses, which qualify under the industrial services, for equipment to communicate with vehicles within their plant or yard areas. These companies would like to communicate with their trucks wherever they are, in or out of the plant. This would be permissible in the Citizens Service, but not in some of the others.

As of June 1958, there were over 140,000 transmitters authorized in the Citizens Service, according to an FCC count. Commission records do not have a breakdown to show the type of user of this service; however, it is safe to say that the applications of the service are practically unlimited. The "Official Registry of Radio Systems in the Transportation Services" shows that almost any type of business enterprise that you can think of uses Citizens Radio.

The pressure from the people who used the old Class A Citizens Band finally had its effect and the FCC changed its rules on August 1, 1958. The new rules save a spot in the middle of the band and the equivalent of the old Citizens station will still be in business for the present. That the citizen got this much was largely due to the strong case presented to the Commission by *Vocaline*.

The remainder of the band, the old Class A allocations, have been excised from the Citizens service and given to others. A total of 6.550 mc. in the 460-470 mc. band has been transferred to industrial services. A total of 2.450 mc. has been retained for use by the Citizens Service. Of this, the FCC warns, 1.900 mc. may be re-allocated later. (See Table 1.)

This is more than a mere change of name of Class A Citizens to industrial, business, or manufacturers' radio. Under Citizens Band rules power was limited and eligibility requirements were simple. The new rules permit more power but tighten eligibility requirements.

The changes in operating authority mean more protection for the industrial class user. The increased power means less protection for the remaining Citizens Band.

Propagation

As mentioned earlier, one of the biggest drawbacks to Citizens Radio has been the erratic propagation characteristics of the band. Of course, no radio at any frequency gives 100% results.

Extensive tests were conducted by the University of Idaho in 1955 to determine the effective range of Citizens Radio. Both *Stewart-Warner's* "Portafone" and *Motorola's* mobile equipment were used in the tests. The following results, obtained with the "Portafone," are indicative of the service which can be expected with low-power, hand-held equipment: level land, desert, meadowland, cropland, 1100 to 1400 yds.; open forest (no underbrush), 1000 to 1200 yds.; dense forest (low branches, close trees), 250 to 300 yds; rolling land (pasture), 1000 yds.; and between hilltops, up to 8 miles.

In mountainous country, communication may extend to 35 miles, between line-of-sight points, but will be nonexistent in cuts and ravines. Over lakes with the antenna three to five feet above the water, the range is less than 1000 yards, according to the University's survey.

In cities, the range was found to be from 300 to 800 yards depending upon building height and street width. Experiments in moving vehicles often produced a "flutter" effect on the received voice. This is due to the multipath reflections and the fact that different waves arrive in different phase relationships. This causes the received signal to fade and restore rapidly, possibly due to the short (25-inch) wavelength.

In mine shafts and tunnels, the range was found to be less than 250 yards. In most cases it was found that moving the transceiver slightly would mean the difference between a signal and no signal.

Equipment

Another handicap to the development of Citizens Radio has been the tricky equipment necessary for use in the 460-470 mc. band. This is a sort of twilight zone in radio, where the lower frequency techniques of coil-capacitor assemblies give way to the butterfly tuners, cavity resonators, and tuned lines.

The Class B service has had an FCC-imposed frequency tolerance of .5% at 465 megacycles, that is, the deviation plus the transmitted band-

Table 1. Shown below is a listing of the new assignments in the old Citizens Band.

THE FORMER 460-470 mc. Citizens Radio Band has been sliced up by the FCC. Very little of this spectrum space has been retained for this service. Here is a listing of the new frequency assignments, effective August 1, 1958:

FREQUENCY IN MC.	BANDWIDTH IN MC.	SERVICE
461.000-462.525	1.525	Industrial
462.525-463.225	.700	Undecided*
463.225-464.725	1.500	Industrial
464.725-465.275	.550	Citizens
465.275-466.475	1.200	Undecided*
466.475-470.000	3.525	Industrial

*Subject to final allocation later. For the present, Class B Citizens stations may be operated in the range 462.525-467.475, with power limited to 5 watts input to the final r.f. stage.

AMONG THE SERVICES which will be assigned in the Industrial bands above are: Business Radio Service, which supersedes the low-power industrial service, and a new Manufacturers Radio Service.

width had to be within plus or minus one-half of 1%. This allowed 4.65 megacycles at the center frequency. Equipment which earned type approval from the Commission had to meet this figure under a temperature range of from 0° to 125°, and had to be able to take the usual knocks and shocks that a portable instrument would experience.

Considerable ingenuity was displayed by manufacturers who qualified their products. The "Portafone" uses a 6AK4 tube as an oscillator and a tuning loop and butterfly arrangement for the 465 mc. tuning unit. A 3A4 modulator tube also serves as an audio amplifier when the set is receiving. The transmitter oscillator tube doubles as a superregenerative detector during reception.

The *Vocaline* uses a u.h.f. television tube, the 6AF4A, as an oscillator in a balanced-transmission-line circuit. A 6AV6 and a 6AS5 comprise a two-stage modulator. Like the "Portafone," the tubes function as superregenerative detector and amplifier when receiving.

Greater ingenuity will certainly be required to meet the .550 mc. bandwidth when and if it finally does go into full effect.

Car-Mobile Service

Probably the users who obtained the greatest range and best performance with Citizens Radio have been Class A users—those who have crystal-controlled equipment operating at the top and bottom of the 460-470 mc. band. Reliable equipment can be had for this service.

Combined transmitter-receiver installations are available at prices from $500 to $700. They are manufactured as mobile units or as fixed station units; some are combinations, that is, they may be changed from fixed to mobile use by simply changing power cords. Mobile stations may use simple ground-plane or coaxial antennas. However, a fixed station which is to communicate with many mobile units may require precisely engineered antennas fed by air-dielectric coaxial lines.

The circuitry used in modern 460 to 470 mc. radios has come a long way from the tricky systems used in World War II radar and transponder equipment. Present day equipment uses sound engineering techniques and the equipment is as reliable as that in any other service. However, because this frequency is in a border region technically, different manufacturers have used different techniques to tune the frequency.

Motorola, for instance, in its 9-tube FM transmitter starts with a 12AT7 oscillator followed by three frequency doublers. A 2C39A lighthouse tube tuned by a cavity then serves as a tripler, which drives another 2C39A in another cavity as a power amplifier. The receiver used with this equipment also uses tuned cavities to reach the 450-470 mc. range.

Communications Co., Inc. 300 Greco Avenue Coral Gables, Florida	Motorola Inc. 4501 W. Augusta Boulevard Chicago, Illinois
General Electric Company Electronics Park Syracuse, New York	Radio Corporation of America Building 2-4 Camden, New Jersey
Kaar Engineering Company 2995 Middlefield Road Palo Alto, California	Royalcall Royal Communications Systems 11462 Euclid Ave. Cleveland 6, Ohio
Vocaline Company of America, Inc. Old Saybrook, Connecticut	

Table 2. Some makers of the type of radiotelephone gear described in article.

While the Citizens Band only actually included 460-470 megacycles, other mobile services are authorized in the ten megacycles which just precede this band. Therefore, most equipment of the crystal-control type is made to handle the 450-470 megacycle band. *G-E, RCA,* and others also make equipment for this service. Output powers usually run from 15 to 20 watts, and the use of FM is common.

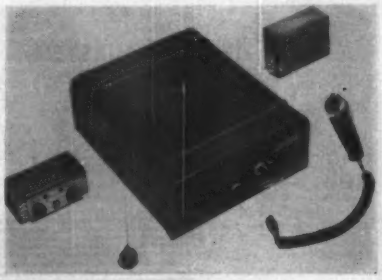
Repeaters and Code Devices

Transmission range of Citizens Radio has been extended by means of repeater stations, which will receive the signal from one transmitter and re-transmit it to a distant receiver. Such a repeater might be located on a hilltop, tall building, or similar advantageous position. Specific frequencies were not assigned to users in the Citizens Band and people who operated in the 460-470 megacycle region had to get along with their neighbors and select or share frequencies as required.

This introduced the possibility that a repeater installed and maintained by one company might be used by any other person who could determine the right frequency to trigger it. This might call for the use of some sort of selective mechanism, which would require knowledge of a predetermined code in order to turn on the repeater unit.

Devices of this sort are now used with radio-dispatch systems where it is desired to alert only one of several mobile units. They can also be used on remotely controlled devices such as garage-door openers which also operate on this Citizens Band service. Typical of equipment of this sort is a decoder unit manufactured by *Secode Corporation* of San Francisco, California. This is an electro-mechanical device known as the "Secode Decoder." It consists of an electromagnet and a code wheel. It can be arranged to respond to any one of several thousand code combinations which can be generated with an ordinary telephone dial. These devices are now widely used by wireline companies to selectively turn machinery on and off at distant points, and are also used by telephone companies to provide dial mobile radio service in automobiles.

The Vocaline series JRC is a complete Citizens Band radio transceiver for Class B use. The unit is designed to operate on either 117 v.a.c. or 6 v.d.c.



The RCA Carfone 450 is a complete mobile transmitting-receiving unit. The separate dash-mounted control and universal mounting speaker are shown.

Cars so equipped may dial other cars or central office numbers. Code devices such as this could help reduce interference in the shared radio service and could also prevent the unauthorized use of repeater stations.

In conclusion then, it would appear that Citizens Radio is looking at its future with some uncertainty. We will just have to keep our eyes on it and on more pending FCC rule changes to see where it goes from here. —30—

LOADING THE PHONO CARTRIDGE

By **HERMAN BURSTEIN**

Get the best performance from your hi-fi pickup by using the proper cartridge loading circuits.

CORRECT loading of the phono cartridge pays dividends in terms of the smoothest and widest frequency response that the cartridge permits and, often, reduced distortion as well. This is true for both magnetic and piezoelectric (crystal and ceramic) pickups—the two most commonly employed types. Load requirements differ widely between magnetic and piezoelectric units. In addition, there are considerable differences among magnetics and among piezoelectrics; merely connecting the cable from the cartridge to a jack designated for a magnetic or piezoelectric pickup doesn't automatically guarantee that all will be well.

The load across a cartridge is both resistive and capacitive. The resistive load consists of a resistor (sometimes a potentiometer or fixed voltage divider) across the input jack or the grid resistor of the input stage, or a combination of the two. The capacitive load includes cable capacitance and input capacitance of the first stage. The latter consists mainly of grid-plate capacitance, which can be quite large in the case of triodes, due to the Miller effect; there is also grid-cathode and stray wiring capacitance. Altogether, it is not unusual for input capacitance to be 50 $\mu\mu$fd. or more in the case of triodes.

In determining load requirements, the inductance, winding capacitance, and d.c. resistance of magnetic cartridges and the capacitance of piezoelectric cartridges have to be taken into account. The following discussion will review the basic principles of loading magnetic and piezoelectric cartridges, taking all the above-mentioned factors into consideration and listing the impedances of a number of popular cartridges and the loads recommended by their manufacturers.

Magnetic Cartridges

Fig. 1 shows the principal circuit impedances when a magnetic pickup is used. The winding contains inductance and d.c. resistance in series, shunted by the cartridge's winding capacitance, the load resistance, and the load (cable and input) capacitance in parallel.

Omitting the resistances, the inductance and total shunt capacitance form a series-resonant circuit, as shown in Fig. 2. Output, across C, is maximum at approximately the resonant frequency, $f = 1/(2\pi\sqrt{LC})$. Therefore response is not smooth but exhibits a peak at f, as shown in Fig. 3. If L and C are relatively small, electrical resonance occurs far outside the audio range and is not a problem.

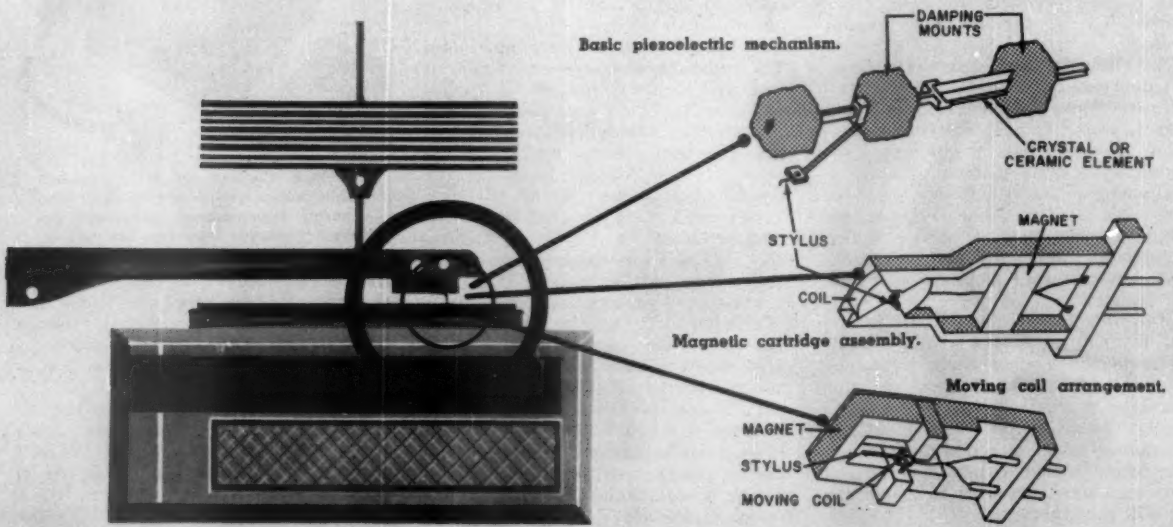
However, high-impedance cartridges, such as the variable-reluctance type, have relatively large inductance, which together with typical circuit capacitance brings f dangerously close to or within the audio range. To illustrate, assume L is .6 henry, which is fairly representative, and that C is 400 $\mu\mu$fd., in large part due to a long length of high-capacitance cable. Therefore f is slightly above 10,000 cycles, producing an audible peak.

One purpose of load resistor R_L is to damp the peak. The smaller R_L, the smaller is the resonant peak. But most things have a price and in the present case what happens is that L and the circuit resistances form a low-pass filter, as shown in Fig. 4. The circuit resistance ($R_L + R_w$) must be large enough to prevent a significant dip in response below 15,000 cycles or so. For example, if L is .6 henry and we select 20,000 cycles as the point where we are willing to let response drop 3 db due to low-pass filter action, then $R_L + R_w = 2\pi fL = 75{,}000$ ohms. Assume that R_w is 1000 ohms. Thus, R_L should be 74,000 ohms. The nearest standard value, 75,000 ohms, is adequate. R_L is not critical and any value within $\pm 10\%$ of the calculated one is generally suitable.

Across the magnetic phono input jack of many control amplifiers there is a load resistor of 47,000 ohms or thereabouts. However, as shown by the example just cited, this can be far too low for some cartridges and, for others, it may be too high. It is important to make whatever changes are required to provide a correct load for the cartridge employed.

Table 1 shows, to the extent that the author has been able to obtain the data, the inductance, d.c. resistance, winding capacitance, recommended load resistance, and permissible load capacitance as given by the manufacturers of a number of popular magnetic pickups. Permissible shunt capacitance (winding, cable, and input capacitance) can be calculated by the formula $C = 1/(4\pi^2 f^2 L)$. L is the cartridge inductance, while a value of 12,000 to 15,000 cycles may be used for f. For ease of calculation, using 15,000 cycles as f, the formula may be put into the form: $C = 113/L$ with C in $\mu\mu$fd. For example, if L is .6 henry, C is about 190 $\mu\mu$fd.

The reader may wonder why, as long as the resonant peak is damped by R_L, it is necessary to keep the resonant



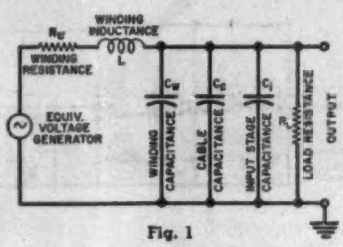


Fig. 1

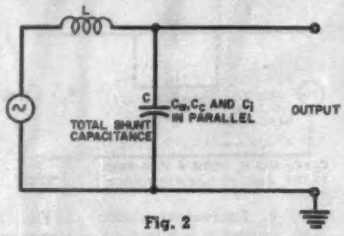


Fig. 2

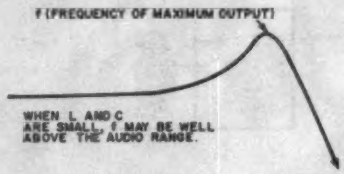


Fig. 3

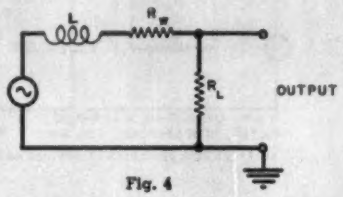


Fig. 4

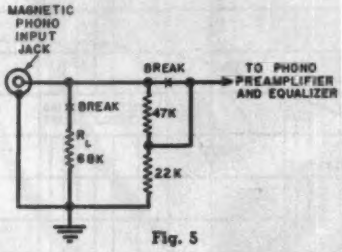


Fig. 5

Fig. 1. Circuit parameters that are associated with a magnetic phono cartridge.

Fig. 2. Resonant circuit produced by winding inductance and shunt capacitance.

Fig. 3. Peak in output due to circuit resonance before adding damping resistor.

Fig. 4. Low-pass filter action produced by inductance and resistances in Fig. 1.

Fig. 5. Converting load resistor to a voltage divider to avoid preamp overload.

peak well up in the audio range or just above it. The answer is that response drops very sharply above resonance, as shown in Fig. 3.

Phono pre-equalization cuts the lows and boosts the highs, requiring the opposite equalization in playback, namely bass boost and treble droop. In a few preamplifiers it has been the practice to supply only bass boost, with treble cut obtained through a suitably small load resistor (for example, the *G-E* Model A1-203); as explained in connection with Fig. 4, winding inductance and circuit resistance—mainly the load resistor R_L—produce treble attenuation.

RIAA equalization, almost universally used today, requires that playback response be 3 db down at 2122 cycles and continue to drop at a rate approaching 6 db per octave. The required circuit resistance is given by $R_L + R_w = 2\pi fL = 6.3 \times 2122 \times L$. To illustrate, if L is .6 henry, then the required circuit resistance is about 8000 ohms. Assume the d.c. resistance of the coil is 1000 ohms. Then R_L should be 7000 ohms. In this case the nearest standard value, 6800 ohms, would be used.

This method of achieving treble cut, prior to the preamplifier, has both advantages and disadvantages. Use of a very small load resistor almost completely damps out resonance. The reduced signal presented to the first stage tends to decrease distortion. A considerable amount of load capacitance can be tolerated without ill effect. On the other hand, signal-to-noise ratio of the playback system is smaller if treble cut takes place before rather than after the input stage; treble cut after the input stage simultaneously reduces noise of this stage.

The problem of electrical resonance ordinarily does not concern the moving-coil type of cartridge, which typically has but a few millihenrys inductance, so that practical values of circuit capacitance place resonance far above the audio range. The load resistor can range in value from a few hundred ohms up to high-impedance loads. The low inductance of the cartridge makes it impractical to obtain treble cut through a suitable load resistor, which would have to be extremely small. Moreover, the relatively low output characteristic of a moving-coil pickup (in exchange for high-quality performance) makes it all the more desirable to obtain reduction of input stage noise concomitant with treble attenuation following this stage.

Some magnetic pickups have quite a large signal output—as much as 100 millivolts on peaks. This might overload the first stage, hence it may be desirable to attenuate the signal from the cartridge. This can easily be done by converting the load resistor to a voltage divider, as illustrated in Fig. 5. Some control amplifiers have an extra input jack intended for high-level magnetic pickups, with a voltage divider across the jack. However, it may be necessary to change these values in order to make their total resistance equal to the load requirement of the cartridge.

Piezoelectric Pickups

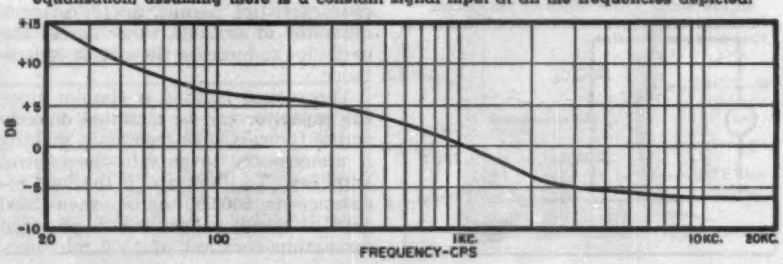
Whereas the output of a magnetic cartridge is proportional to groove velocity, the output of a piezoelectric cartridge is proportional to groove amplitude. As a result of RIAA pre-equalization, groove amplitude varies with frequency in the manner shown by Fig. 6; there is a good deal of bass boost and a moderate amount of treble cut on

CARTRIDGE	INDUCTANCE	D.C. RES.	WINDING CAP.	RECOMMENDED LOAD RES.	MAXIMUM LOAD CAP. (Note A)
Audiogersh MST-1(Note B)	320 mhy.	1400 ohms	Note C	47,000 ohms	200 μμfd.
Audiogersh MST-2	Note C	Note C	Note C	100,000 ohms	200 μμfd.
Electro-Sonic C-60	1 mhy.	40 ohms	Unmeasurable	100 to 100,000 ohms	Very large (Note D)
Electro-Sonic P-60	1 mhy.	40 ohms	Unmeasurable	100 to 100,000 ohms	Very large (Note D)
G-E VR-II (Note E)	520 mhy.	600 ohms	about 50 μμfd.	100,000 ohms	300 μμfd.
G-E VR-II (Note F)	250 mhy.	400 ohms	Note C	100,000 ohms	300 μμfd.
Grado F2BD	Very low	600 ohms	Note C	5000 ohms & up	Note J
Norelco AG3121	600 mhy.	1200 ohms	70 μμfd. (Note G)	68,000 ohms	250 μμfd.
Shure "Studio Dynetic"	130 mhy.	180 ohms	40 μμfd. (Note H)	10,000 ohms	1500 μμfd.
Shure "Professional Dynetic"	350 mhy.	440 ohms	30 μμfd. (Note I)	27,000 ohms	Note C
Tannoy "Mark II"	320 mhy.	1100 ohms	230 μμfd.	100,000 ohms	150 μμfd.

NOTES: A = cable capacitance and input stage capacitance; B = model with diamond stylus; C = information not supplied by manufacturer; D = the manufacturer states, "The cartridge will be unaffected by any cable or tube capacitances encountered"; E = high-impedance model; F = low-impedance model; G = calculated on basis of resonant frequency at 25,000 cycles, per manufacturer; H = calculated on basis of resonant frequency at 70,000 cycles, per manufacturer; I = calculated on basis of resonant frequency at 90,000 cycles, per manufacturer; J = cables in excess of 10 feet may be used.
For information on cartridges not covered, contact the manufacturers direct.

Table 1. Characteristics and loading for some representative magnetic cartridges.

Fig. 6. Variation of the groove amplitude with frequency due to RIAA recording equalization, assuming there is a constant signal input at all the frequencies depicted.



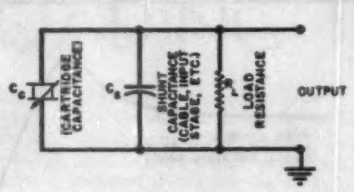


Fig. 7. Circuit parameters that are associated with a piezoelectric cartridge.

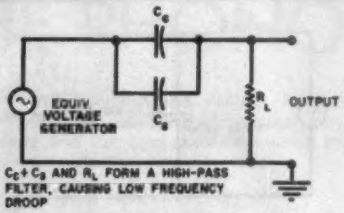


Fig. 8. Equivalent circuit of Fig. 7 with respect to low-frequency response.

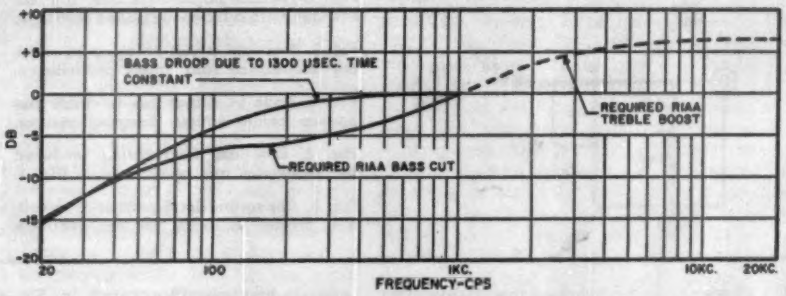
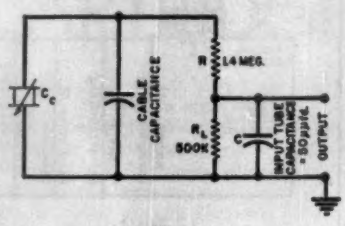


Fig. 9. Comparison of RIAA bass cut required when using amplitude-responsive pickup with bass droop produced by circuit impedances having time constant of 1300 μsec.



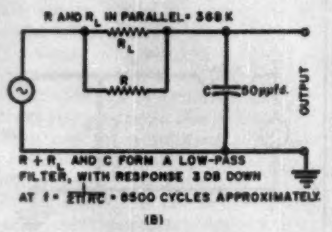


Fig. 10. (A) Effect of using a voltage divider as load resistor for piezoelectric cartridge is shown here. (B) Equivalent circuit of Fig. 10A at high frequencies.

the record. Thus, when a piezoelectric cartridge is used for playback, bass *cut* and treble *boost* are required, which is just the opposite of the requirements for a magnetic cartridge.

Fig. 7 shows the basic circuit elements when a piezoelectric cartridge is used. Fig. 8 is the equivalent circuit and it can readily be seen that the circuit capacitances, effectively in parallel as far as frequency response is concerned, form a high-pass filter in conjunction with the load resistor. In other words, these elements produce bass cut. To achieve bass cut that corresponds fairly accurately to RIAA requirements for an amplitude-responsive cartridge, the time-constant of the total circuit capacitance and the load resistor should be between approximately 1000 and 1300 microseconds. This means a bass droop characteristic with a turnover frequency (3 db decline) between 160 and 120 cycles and declining thereafter with decreasing frequency at a rate approaching 6 db per octave. Fig. 9 compares the required RIAA bass droop with that achieved by circuit elements having a time-constant of 1300 microseconds (120-cycle turnover frequency).

The principal circuit capacitance is usually that of the cartridge, varying from about 400 μμfd. to as much as 2000 μμfd. The other circuit capacitances, chiefly that of the cable and the input tube, have a total value which typically ranges from 150 to 250 μμfd., although a long run of high capacitance cable can raise this figure appreciably.

To illustrate the method of calculating the required load resistance to produce the correct amount of bass droop, assume that the pickup has 500 μμfd. capacitance and that cable and input tube capacitance totals 200 μμfd. To obtain a time-constant of, say, 1300 microseconds with circuit capacitance of 700 μμfd., the load resistor has to be about 1.9 megohm. The nearest standard values of 1.8 or 2 megohms will work satisfactorily.

The signal output of a piezoelectric cartridge may, in some cases, reach as much as 1 or 2 volts on peaks, indicating that these pickups are meant to be connected to high-level inputs. But the typical input impedance at the high-level jack of a control amplifier is 500,000 ohms. This is too low for most piezoelectric cartridges, that is, the time-constant of the circuit capacitances and load resistor will cause too much bass cut.

The remedy is simple: either (1) increase the input impedance to the required value, perhaps by changing the grid resistor of the input tube, if its characteristics permit, or (2) place a capacitor of suitable value across the cartridge to increase the circuit capacitance.

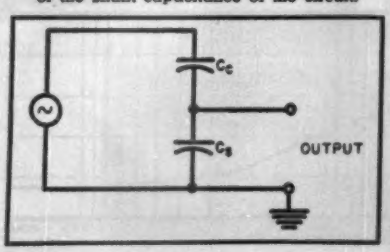
The second method is simpler since the capacitor can be mounted directly across the cartridge terminals, making it unnecessary to go into the control amplifier. To illustrate, if the load resistance is 500,000 ohms, then 2600 μμfd. of circuit capacitance is required for a time-constant of 1300 microseconds. Assuming the capacitance of the cartridge, cable, and input stage total 700 μμfd., then another 1900 μμfd. of capacitance is required. A capacitor of .002 μfd. across the cartridge would be close enough in value to achieve the objective of correct bass attenuation.

If the volume control of the control amplifier follows rather than precedes the input stage for high-level sources, this stage may be overloaded by the signal from a high-output cartridge. It might seem that the simplest way to attenuate the signal would be through use of a voltage divider as the load resistance (see Fig. 5). Generally, however, this is a poor idea because it may well entail substantial high-frequency loss. Fig. 10 shows why. Fig. 10A represents a voltage divider having a total resistance of about 2 megohms and with the values chosen to produce about 12 db attenuation. The input capacitance of the first stage is assumed to be 50 μμfd., a plausible value. Fig. 10B is the equivalent circuit for high-frequency response. The load resistors are effectively in parallel and this parallel value forms a low-pass filter in conjunction with the input capacitance. For the values shown, namely, effective parallel resistance of 368,000 ohms and 50 μμfd. capacitance, high-frequency response is 3 db down at about 8500 cycles, declining thereafter at a rate approaching 6 db per octave.

Thus it is better to attenuate the signal by means of a shunt capacitor of suitable value connected across the cartridge. Fig. 11 shows how the cartridge capacitance and the other circuit capacitances effectively form a voltage divider. The bottom leg of the voltage divider consists of the parallel value of all the circuit capacitances other than the cartridge. If the capacitance of the bottom leg is increased, its reactance

(*Continued on page* 127)

Fig. 11. Shown below is the equivalent circuit of Fig. 5 with respect to the voltage divider action produced by means of the shunt capacitance of the circuit.



WIDE-RANGE FIELD-STRENGTH METER ADAPTER

Figs. 1 & 2. The adapter (top right), showing the calibrated 3-band dial. At left, it is shown with a whip antenna, plugged into the author's v.o.m.

By **GENE BRIZENDINE**

A simple, plug-in unit gives you signal-strength readings from 1.6 to 170 mc. on your test meter.

THIS TINY adapter will quickly turn your volt-ohm-milliammeter into a very wide-range field-strength meter, useful for many purposes. The unit (Figs. 1 and 2) covers the surprising spectrum of 1.6 to 170 megacycles, in only three ranges. Such wide coverage is made possible by the high maximum-to-minimum ratio of the midget tuning capacitor, C_1.

With this adapter, non-oscillation of a TV set's local oscillator may be quickly found. Two-way mobile transmitter output may be peaked. Oscillating i.f. stages may be localized.

Using the sensitive microammeter movement of the average service-type volt-ohm-milliammeter, the circuit (Fig. 3) comprises a pickup antenna, a three-range tuning tank, a germanium diode, and output plugs.

The compact adapter can be assembled in a plastic parts box measuring 1" high, 1⅜" wide, and 2¹¹⁄₁₆" long, as shown in Fig. 4. Being this small, the device does not overhang the v.o.m. and seems to be a part of the meter.

The bottom half of the plastic box contains two pin-tip plugs, which mate with the meter's measuring jacks. Also, a large hole accommodates the v.o.m.'s function knob, allowing the adapter to fit flat onto the meter. A *Simpson* 260 meter is shown, but other makes are equally adaptable.

The top half of the box is drilled to mount the tiny tuning capacitor, the range selector, and the antenna pin jack. A coat of black enamel, applied *inside* the case, results in a glossy finish.

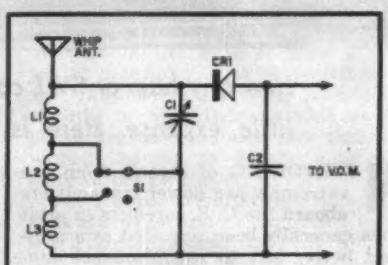
Three ranges, "High," "Medium," and "Low," are indicated by decal letters on the range knob. A spot of white enamel on the adjacent antenna jack serves as the index for the range knob.

The medium-range, 5-to-30 megacycle coil (L_2) is simply a TV filament choke, "pruned" to cover this range by removing four turns of wire. The low-range (L_3) coil (1.6 to 5 mc.) is made of one pi section removed from a small 2½-millihenry r.f. choke. This section is cemented at one end of the medium-range coil, to conserve space. The high-range (L_1) coil (30 to 170 mc.) is formed of 2 turns of #16 enameled wire, 9⁄32" in diameter. This may be wound on any smooth, round form, after which the form is removed. Care in soldering to the germanium diode and other delicate components is necessary to avoid damage from heat.

Calibration of the finished unit is best accomplished with a signal generator loosely coupled to the adapter. The generator dial readings are transferred to the adapter dial, after locating the maximum meter reading by means of the adapter tuning knob. This process is repeated for each mark desired.

During adjustment of transmitters and associated antennas, a short whip antenna may be plugged into the adapter's jack for greater sensitivity. For close-in chassis explorations, the antenna is removed. In this application, the adapter is held close to the various stages to detect any desired or undesired oscillations. —50—

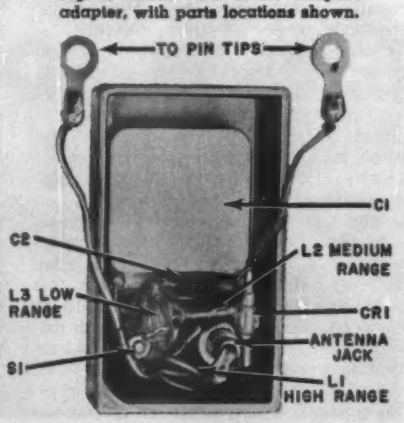
EDITOR'S NOTE: *Something familiar about this device? If there is, you have a good memory: the author described "A V.H.F. Field-Strength Meter Adapter" back in January 1957, on page 71. The present variation covers a wider range, made possible by the tuning capacitor used, which overlaps the frequency coverage of its precursor. You may find it interesting to compare the two.*



C_1—10-365 μμfd. tuning capacitor (Lafayette MS-274 or equiv.)
C_2—.005 μfd. bypass capacitor (Aerovox P83Z or equiv.)
S_1—S.p. 4-pos. miniature switch (Lafayette SP-88, two positions plus "off" position used)
CR_1—1N56 germanium diode
L_1, L_2, L_3—See text

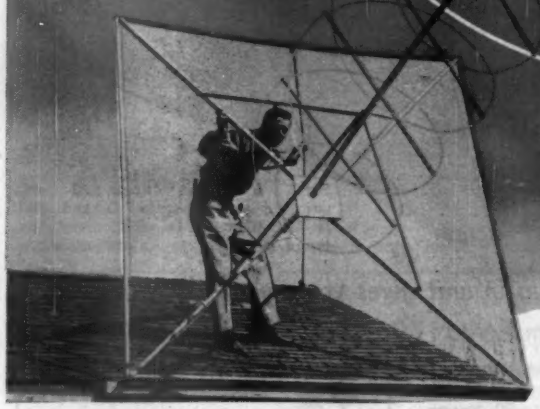
Fig. 3. Schematic and parts list for the simple, wide-range f-s adapter.

Fig. 4. Inside view of the compact adapter, with parts locations shown.



Listening to the SATELLITES

By E. C. KUNZE, WØWVM



Author sets up his helical antenna.

How any ham or SWL can get good results with little expense. Here is one ham's experience.

MONITORING of signals from the extremely low power transmitters aboard the U. S. satellites in orbit has generally been regarded as a project better left to the Minitrack stations, the major radio observatories, and other elaborate and expensive receiving stations. It is, however, entirely possible for any ham or SWL to build and equip his own shack with simple gear for satellite reception and to get good results with little expense.

It is definitely not necessary for the receiving station to be located under, or even near, the orbits. The signals can be picked up from surprisingly great distances at usable intensities. DX of four- to five-thousand miles is a regular occurrence and the signal strength, even at that distance, is usually several "S" units above the noise level. Any time or money invested in building a layout for monitoring the 108 megacycle channels will pay off as a fascinating activity for any radio man. Probing space for signals from earth satellites provides the rudiments of what can and will be done on this new frontier in the next few years.

Without question the most important piece of equipment is a good antenna. A "good" antenna for this purpose is one that has at least 10 db forward gain, is adjustable in both azimuth and elevation, and has a low-loss, matched transmission line. A well built, carefully adjusted 108 mc. crystal-controlled converter is an advantage, but satisfactory results can be obtained with simpler types, if care is taken to stabilize the oscillator and to reduce the r.f. stage and mixer noise to a minimum. A communications receiver with good selectivity will be needed as an i.f. channel. Other required equipment includes a world globe, a caliper, and plenty of pencils, paper, and patience.

Since the launching of Explorer I, the monitoring project here at WØWVM has, like Topsy, "just growed." The first signal from the high-power transmitter of 1958 Alpha was heard toward the end of its eleventh orbit and was recorded on tape along with time checks from WWV in order that any data received would be pinpointed as to time. Nine passes of the 60 milliwatt AM transmitter were recorded before it failed. The signal strength was much higher from that transmitter than from the other lower power satellite transmitters that have since been heard and recorded at this location.

After the high-power signal was off the air, attention was turned to the low-power signal. Subsequently, over 50 passes of the 10 milliwatt phase-modulated transmitter of 1958 Alpha have been taped and logged as part of a study of propagational effects as observed from this northern location (St. Paul, Minn.).

Vanguard (1958 Beta) has been recorded numerous times beginning with transits numbers 8, 9, 10, and 11. Both the 108 mc. battery transmitter and the 108.03 mc. sun-powered transmitter were readable, although the fast fading effect made it impossible to demodulate telemetry. It is, incidentally, a weird experience to hear the solar-powered transmitter chugging along up there in the sun at midnight.

Explorer III (1958 Gamma) has been heard and recorded a number of times but, as Alpha is of prime interest, these Gamma passes have been logged simply to prevent confusion as to which is which, because both Alpha and Gamma sound the same.

Depending on the altitude of the satellite at the time of transit over or near the United States, the duration of a "radio sighting" varies from several minutes to as long as forty minutes. This allows sufficient time to lay out the orbits on the globe and keep a running check as to just where the satellite is at any given moment. Alpha has been followed by radio from points several thousand miles out over the Pacific Ocean and at other times as far to the east as the coast of Africa. As a matter of fact, the first three satellites that were launched were followed for these great distances when in or near apogee at the time of transit. The term apogee (opposite of perigee) is defined for this purpose, as the point in the orbit at the greatest height.

Precise information about the orbits can be readily obtained by tuning to the nightly voice broadcasts of satellite prediction data on the command station VPØ on 4275 kc. at 1900, 2000, and 2100 EST. Regional repeats of this data are given at 2030 local standard time by other CAP stations on channels slightly higher in frequency. The time and longitude of the satellite's northern vertex is given on these transmissions. The "vertex" is defined as "the northernmost point of sub-satellite trace." This, and other information on the orbits as given in these broadcasts, is of value in determining when and where to listen for a pass.

Lacking current vertexing informa-

tion, it is still possible to pick up signals and plot a trace for that particular pass. Several characteristics of the received signal are informative as to position. The Doppler shift effect and the fading pattern alone will indicate whether the satellite is approaching, is at the point of nearest approach, or has passed and is receding in the distance. Rotation of the beam antenna onto the satellite is also an aid in getting a fix. A simple signal-strength check is of help in many cases, but it must be remembered that, in general, the signal strength is greater when the signal source is over water than when over land. (This is probably less often the case in the southern half of the United States since the satellites do, at times, pass directly overhead in which instance the signals would be very strong.) The arid regions of southwestern USA and northern Mexico cause a noticeable drop in signal strength when the satellite is over those areas. Given one reasonably good fix on a satellite, it is not difficult to plot the next orbit or the orbits for the next day or even the next week (except for Gamma, which has been officially labeled as having an erratic orbit).

A tape recorder has been of help in keeping a running log of propagational effects as well as a record of the satellite sounds and time checks. A microphone was hooked into the circuit, and a running commentary could then be injected to give signal-strength readings, computed position, or any other normal or abnormal effects that were being noticed at the time. Among these effects are such things as abnormal propagation *via* auroral bounce from extreme distance, effective blocking out of the signal by aurora, surges in signal strength, and sudden shifts in the frequency of the signal. (Some of the surges and shifts were very likely caused by reflections of the signal from meteor trails or from ion clouds set up by another satellite.) The most consistent and recurring effect was the definite drop in signal strength when the satellite passed over land masses. Occasionally more than one satellite has been heard at the same time—sometimes so close together in both frequency and position as to make separation and identification difficult.

Few, if any, of these observations would have been possible without the aid of efficient antenna systems. Two beam antennas are now in use, one being the eight-element stacked yagi array initially set up for the project. This one can be rotated horizontally, but cannot be tilted upward so as to "look" directly at the satellites when they are at high altitude over the United States. The other is a helical antenna with a rather large ground screen backing it up. This one can be raised or lowered to any angle on the meridian. These two antennas make it possible to receive the signals with good strength during passes vertexing in the western hemisphere.

THIS MONTH'S COVER

AUTHOR Kunze is setting up his high-gain helical antenna on the roof of his home. The antenna is being oriented upward for optimum reception of satellite signals. The helix is made up of a 75-foot length of quarter-inch aluminum wire, wound to form a 6-turn coil, 40 inches in diameter with a turn separation of 26 inches. The reflecting screen behind the helix is 8 feet square and is made of ordinary chicken wire. Open-wire transmission line, connected to the antenna through a matching stub, is led down into a 108-megacycle converter in the shack. Antenna gain is in excess of 10 db. (Photograph by Warren Johnson, WØNGF.)

The main line run to each antenna is made with 250-ohm (u.h.f. type) open-wire transmission line. The horizontal yagi, being a balanced device, is matched to the line by a linear (quarter wavelength) transformer to step up the rather low antenna impedance to the impedance of the line. At the other end of the line, a balun is used to provide an unbalanced, low-impedance feed to the receiving equipment. A balun is also used at the connection to the helical antenna in order to convert from the unbalanced antenna output to the balanced feedline. A d.p.d.t. toggle switch is used at the operating position to select antennas.

The helix consists of about 75 feet of ¼-inch aluminum wire, that is wound to form a 6-turn coil, 40 inches in diameter with a turn separation of 26 inches. The ground screen is made of chicken wire and measures 8 feet square. The matching device is a half wavelength open stub, made by simply bringing the bottom end of the helical winding out from the spiral and into a straight line three inches from the screen, and parallel to it for 56 inches. The transmission line is connected 18 inches from the open end of this stub.

The gain and performance of the two antennas is about the same, with the notable exception that the circularly polarized helix is less sensitive to man-made noise by a marg'n of three or four db. This feature of the helix is a definite advantage when working with low-intensity signals in an average residential area. Solar noise is at a high level in the late afternoon and early evening but neither that nor persistent ignition noise has been too troublesome at this location and at the frequencies involved. During the very early morning hours the noise level is lowest and it is then possible to demodulate telemetry from the low-power Explorer signals. Even though narrow-band phase modulation is used in these transmitters, the AM detector in the receiver does a fair job of detection. It is suspected that the transmitters are being modulated slightly in amplitude as well as in phase, because the tones come through without having to detune onto the slope of the i.f. curve.

The 108 mc. converter used here consists of a 417A first r.f. amplifier, feeding a grounded-grid 6AJ4 second r.f.

(*Continued on page* 104)

The author is running his 108-megacycle converter through his receiver in this photo.

Basics of Preset Counters

By **ED BUKSTEIN**
Northwestern Television and Electronics Institute

Widely used in counting and packaging operations, these circuits are finding increased acceptance in industry.

THE PRESET COUNTER is one which produces an output pulse after it receives a number of input pulses determined by the settings of the front-panel controls. Since these settings can be changed, the preset counter can serve as a variable-ratio frequency divider. Units of this type are widely used in counting, batching, and packaging equipment.

In pill-packaging operations, for example, the preset counter is often adjusted to produce one output pulse after it receives one hundred input pulses. These input pulses are produced as the pills fall through a light beam, blocking illumination to a phototube. As the hundredth pill passes through the light beam, the preset counter produces an output pulse. This pulse is used to actuate a gate mechanism which directs the pills into the next bottle on a conveyor belt. Similar arrangements are used for packaging screws, washers, machined parts, etc.

Purely mechanical counters can, of course, be used to control packaging operations, but only at a considerable sacrifice of speed. Since the production rate is a primary consideration in any manufacturing operation, the electronic preset counter is used extensively. For example, the pill-packaging operation just described is accomplished at a rate of 15,000 pills per minute. Many of the commercially available preset counters operate at rates in excess of 50,000 counts per second so that the counting operation is no longer the weak link in the chain of production. Another significant advantage of the electronic counter over a purely mechanical system is that the ratio can be changed simply by setting front-panel controls. A similar change in a mechanical system requires gear and cam adjustments.

Most preset counters consist basically of a cascade of flip-flop (binary) stages. The maximum ratio of such an instrument would therefore be 2^n, where n is the number of stages. In the preset counter, *binary preset* switches can be adjusted to cause an output pulse after any number of input pulses up to the maximum ratio. A four-stage flip-flop, for example, will have a maximum ratio of 2^4 or 16. The binary preset switches, however, can be adjusted to make the circuit produce an output pulse after any number of input pulses fewer than 16.

Table 1 shows the normal switching sequence of a four-stage flip-flop circuit. The figures 0 and 1 in this table are used to indicate the conditions of the flip-flop stages. A stage is considered to be in the 0 condition when its left-hand tube is cut off and the right-hand tube is conducting. The opposite condition is represented by a 1. (See "Basic Binary Counting Circuits" in the May, 1958 issue of RADIO & TV NEWS.) It is apparent from Table 1 that the maximum ratio is 16 and that this ratio will be achieved if all four stages start in the 0 condition (0000). The output pulse is produced when the fourth stage switches back to the 0 condition at the time the 16th input pulse is applied.

If the four flip-flops are started in some condition other than 0000, fewer than 16 pulses will be required to produce an output pulse. Assume, for example, that the circuit is adjusted to the 0110 condition at the start. As shown in Table 1, this condition would normally be attained after 6 input pulses. If the circuit is started in this condition, only 10 actual input pulses will be required to complete the switching sequence and to produce an output pulse. This technique is known as *complement setting*, because 6 is the complement of 10 with respect to the maximum ratio of 16. Likewise, if we wish to obtain an output pulse after 7 input pulses, we would start the circuit in the condition representing 9 which, as Table 1 shows, would be 1001.

Any desired starting conditions can be set up by means of the binary preset switches which are wired as shown in Fig. 1. The switches are shown in position No. 12. The circuit will therefore produce one output pulse for every 12 input pulses. This would be the case,

Fig. 1. The circuit of a basic preset counter is shown here. When the relay is energized, a positive potential is applied to one of the two grids for each stage. Which grids will receive this positive voltage is determined by the positions to which the switches are preset. The circuit can be adjusted to produce an output pulse after any number of input pulses up to sixteen.

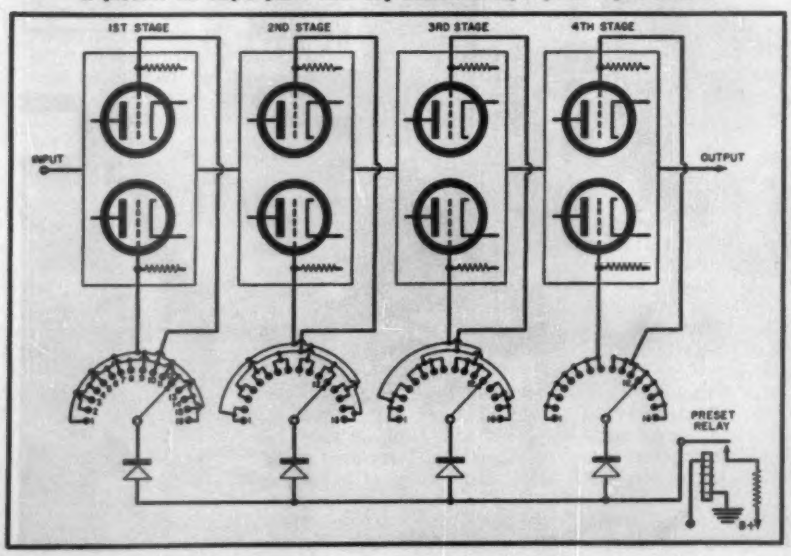


Table 1. Normal switching sequence of a four-stage flip-flop circuit. The figures "0" and "1," as used here, indicate the conditions of the flip-flop stages. Refer to text for details on how notation applies.

INPUT PULSE	4TH STAGE	3RD STAGE	2ND STAGE	1ST STAGE
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1
16	0	0	0	0

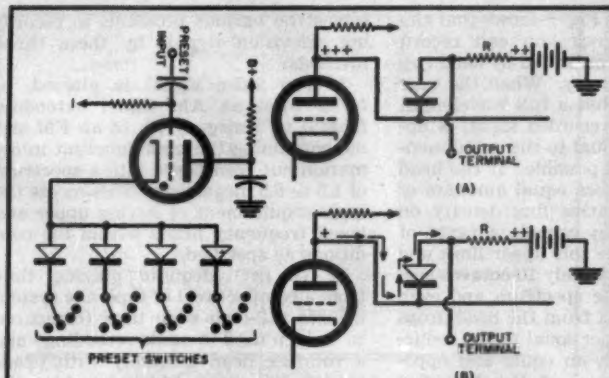


Fig. 2 (left). Thyratron used in place of preset relay permits high-speed operation. When thyratron is fired by input pulse, "B+" is applied to flip-flop grids through preset switches.

Fig. 3 (center). (A) When flip-flop tube is cut off, its plate voltage is high and diode is biased in reverse direction. As diode is not conducting, there is no drop across R and supply voltage appears at output terminal. (B) When flip-flop tube is conducting, its plate voltage is low and diode is biased in forward direction. Current flow causes most of supply voltage to be dropped across R, leaving little at output.

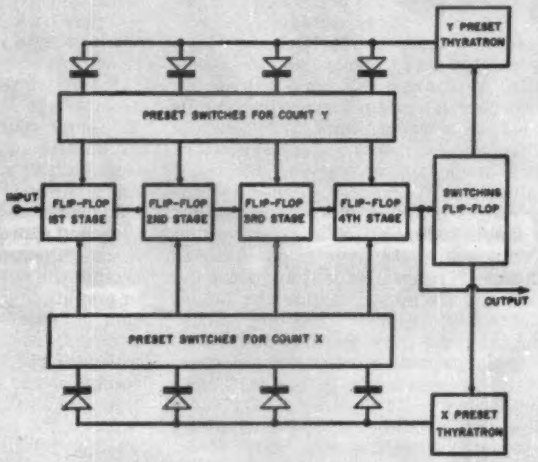


Fig. 4 (above). The dual preset counter alternately presets to two different numbers. Each output pulse from 4th stage reverses the switching flip-flop and fires one preset thyratron.

for example, if we wished to use this circuit to control a packaging operation requiring one dozen items in each package. With the preset switches in the "12" position, the flip-flop stages are preset to represent a count of 4 (the complement of 12 with respect to 16).

The presetting operation is accomplished by energizing the preset relay. The contacts of this relay now apply a positive potential, through the preset switches, to the grids of the following tubes: right-hand (upper) grids of the first, second, and fourth stages and left-hand (lower) grid of the third stage. These tubes will therefore conduct and the four stages will be preset to 0100. As Table 1 shows, this represents a preset count of 4. Since the circuit starts in the 0100 condition, only 12 input pulses will be required to complete the switching sequence all the way to 0000.

After 12 input pulses have been applied to the circuit shown in Fig. 1, the circuit is in the 0000 condition. To repeat the operation for another count of 12, the circuit must be preset again to 0100. This can be accomplished automatically by feeding the output pulse from the fourth and final stage to the preset relay. In this way, the circuit will automatically preset to 0100 after every 12th input pulse.

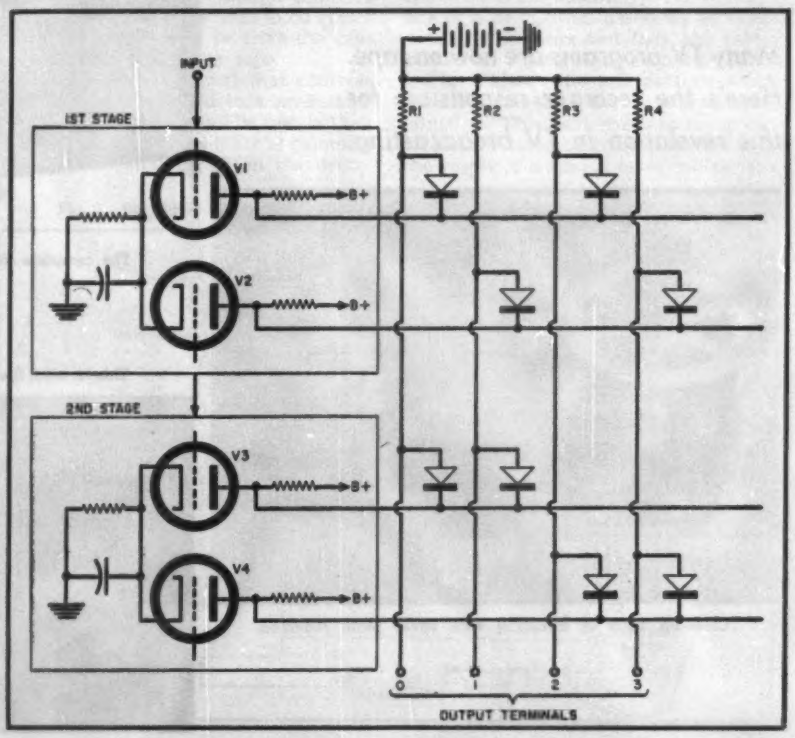
When counting rates are too high to permit the use of the preset relay, it can be replaced by a tube, as shown in Fig. 2. After every 12th input pulse, the thyratron is fired by a positive pulse from the left-hand plate of the fourth stage. The "B+" voltage is now connected, through the conducting thyratron, to the proper grids to establish the 0100 condition. The capacitor connected to the plate of the thyratron provides for automatic shut-off of the tube. After the thyratron is fired and has done its job of applying positive potential to the preset switches, this capacitor discharges through the tube until the plate voltage is brought down to the de-ionization value.

The diodes shown in Fig. 1 are used for isolation. They prevent interaction between grid circuits, which would otherwise be connected together through the preset switches. Four stages are shown in Fig. 1, but the same technique can be extended to include any number of stages. The preset switches are of the multi-position rotary type, with one deck for each flip-flop stage.

The *dual preset counter* is one which will preset alternately to two different numbers. A block diagram of this type of instrument is shown in Fig. 4. Assume that the four stages are initially preset for a count of *X*. After *X* input pulses have been applied, the fourth

(*Continued on page* 142)

Fig. 5. The diode matrix consists of an array of vertical and horizontal wires, some of which are connected by diodes. As input pulses are applied to flip-flop, output pulse will transfer from one output terminal to the next. Each output terminal is numbered to indicate the required number of input circuit pulses.



How the Videotape Recorder Works

Many TV programs are now on tape. Here's the recorder responsible for this revolution in TV broadcasting.

By **JOSEPH ROIZEN**

Ampex Corporation

SINCE the advent of magnetic tape recording in the audio field and as its inherent advantages of good quality, immediate playback, and tape reusability were recognized, the possibility of utilizing the same process for recording television images has stimulated engineering minds.

As video and audio information are both made up of varying electrical voltages, differing only in the frequency ranges involved, it would seem that a simple extension of audio recording techniques would serve to put pictures on tape. This, unfortunately, is not the case and we must examine the fundamentals of magnetic recording to understand the problems involved.

It is a paradox of magnetic recording that you cannot put both a very high and a very low frequency on the same tape and expect to get good output and adequate signal-to-noise ratio from both. The range of audio signals (30 to 15,000 cycles) represents about the maximum latitude possible. But video frequencies extend from nearly d.c. to above 5 megacycles!

The diagram of Fig. 1 shows that the maximum frequency you can record and play back is controlled by head gap size and tape velocity. When the tape velocity is such that a full wavelength (1 cycle) of the recorded signal is approaching or is equal to the gap dimension, no output is possible. If the head instantaneously sees equal amounts of positive and negative flux density on the tape, then they cancel. A range of frequencies before this upper limit and spanning approximately 10 octaves represents the usable spectrum and even though the output from the head drops in amplitude proportional to the reduction in frequency, an equal and opposite response curve of the amplifier following the head will correct for this condition and give usable output over this range.

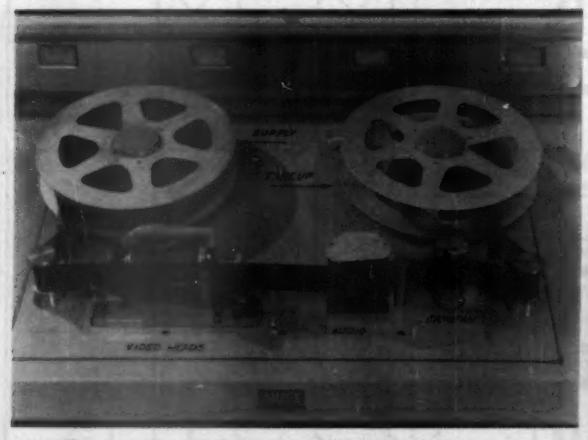
Since the head output is dependent on the *rate of change* of flux density, we soon reach a low limit where the rate becomes so slow that no useful output can be obtained and the signal-to-noise level becomes prohibitive. The *Ampex* VR-1000 "Videotape Recorder" solves the various problems in recording television signals by these three methods:

1. The video signal is altered, in form, from an AM signal extending from 0 to 5 megacycles to an FM signal containing the same inherent information but transposed into a spectrum of 1.5 to 6.5 megacycles. This meets the basic requirement of having upper and lower frequency limits within the conditions as specified.

2. To get adequate playing time from a compact reel of tape, the system utilizes a 2-inch wide tape (compared to ¼-inch used in audio recording) and a rotating head assembly with heads spaced 90° apart which provides the high head-to-tape velocity (1500 ips) necessary for recording the very high frequencies involved.

3. Precision-made head assemblies and a very accurate servo system make it possible to play tapes made on one machine on any other machine adjusted to established standards. This allows for interchangeability of tapes between users in the United States and

The complete machine comprises two racks and console.



Close-up view of transport with cover plate removed.

This is what the video head assembly looks like.

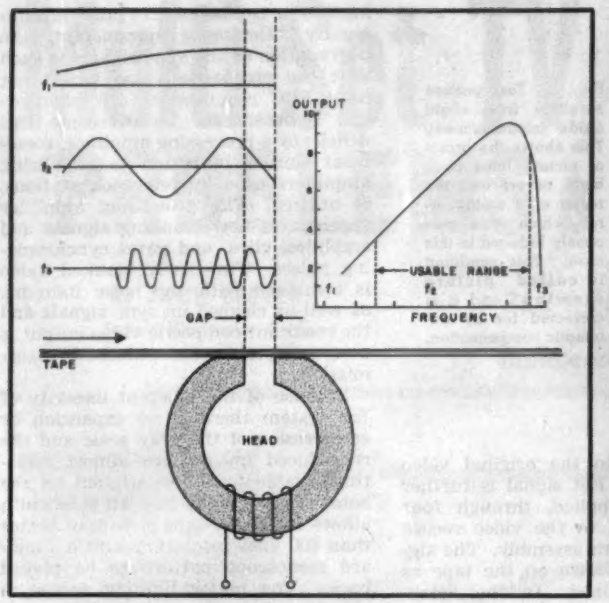


Fig. 1. Maximum frequency is controlled by gap and tape speed.

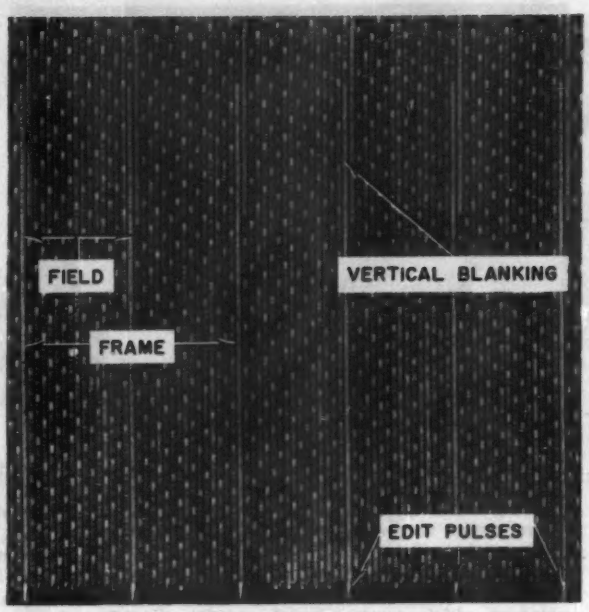


Fig. 2. A "visualized" tape with a monoscope pattern recorded.

Canada and, in some cases, even with foreign countries. It also permits commercials made on different machines to be spliced in with program material recorded at a different locale.

The "Videotape" unit is capable of recording for indefinite storage or immediate playback (without processing) a complete television program of up to 90 minutes in length, including both picture and sound. A standard one-hour reel is 12 inches in diameter and holds approximately 4800 feet of tape. The tape consists of a specially manufactured Mylar base, 1 mil thick, coated with oxide on one side. It can be re-recorded over 100 times. Tape speed is the standard 15 inches-per-second employed in professional audio recording equipment.

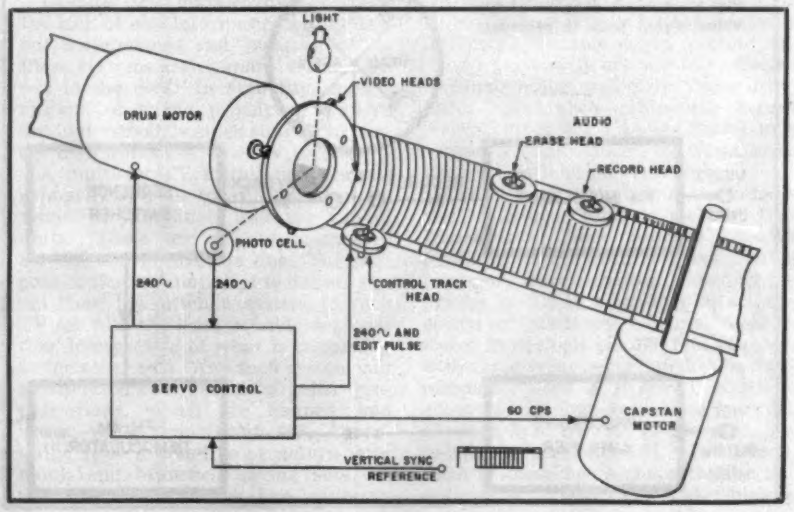
The recorded signals include the picture information (video) laid down at right angles to the tape by the rotating head assembly. The sound portion is recorded along the upper edge of the tape with the timing reference signal (control track), the cue track, and edit pulses recorded at the lower edge. Although these signals are invisible to the naked eye, it is possible to bring them up for editing and splicing purposes. Fig. 2 shows a "visualized" tape which has a monoscope pattern recorded on it. The transverse lines carrying the video signal are 10 mils wide with a 5 mil spacing between them. Each scan of one head in the drum assembly covers 16 to 17 active television lines. Enough overlap of video information is available so that there is ample time for switching from head to head while maintaining proper continuity.

Fig. 3 is a simplified diagram showing the "Videotape Recorder" in the "record" mode. Vertical sync signals derived from incoming video information are used as a reference for maintaining the rotational speed of the drum motor at exactly 240 revolutions-per-second (14,400 rpm). The servo loop picks the signal from the head assembly off a photocell and feeds it back to the servo control unit for comparison with vertical sync. The resultant is used to control the speed of the drum motor. The photocell signal is also recorded on the bottom edge of the tape by the control-track record head as a timing reference to be used in playback and the edit pulses are superimposed on it. Two binary counters reduce the 240-cycle signal to 60 cycles —the frequency used to drive the capstan motor pulling the tape.

The same video signal that controls the drum servo is fed to a modulator which transforms it to FM and is then applied through four identical channels to the individual heads on the drum. A slip ring and brush assembly serve to transfer the signal to the head drum. Since only one head at a time is in contact with the tape, each head lays down its track in sequence. To maintain a perfect pressure gradient across the tape in contact with the revolving heads, the tape is held in a concave guide by an applied vacuum. This guide can be minutely adjusted to make playback time exactly equal to record time even when the head wear has somewhat reduced the diameter of the head drum assembly. The average life of a head drum assembly is in excess of 100 hours and they are refurbished on a rotational exchange basis.

Fig. 4 shows the test pattern which results when the guide is slightly misadjusted. This demonstrates the group of picture lines each head covers and the result of a timing error which was

Fig. 3. Simplified diagram showing "Videotape Recorder" in the "record" mode.



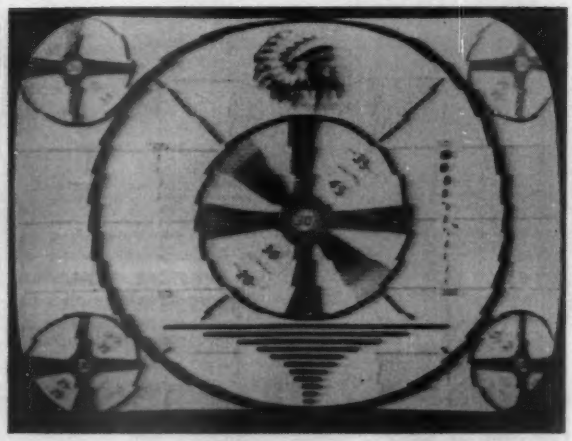


Fig. 4. Test pattern resulting from slight guide misadjustment. This shows the group of picture lines each head covers and the result of a timing error which was purposely induced in this case. This condition is called "picture skewing" and it is corrected for by automatic compensation.

purposely induced in this case. We refer to this condition as "picture skewing" and an automatic compensating device corrects for it.

The edit pulses along the bottom edge of the tape are referenced to vertical sync and serve to locate the exact point at which a splice can be made so that it will occur during vertical blanking and be invisible to the viewer. An accessory precision splicer performs this function very simply and with the required amount of accuracy.

We will now follow the path of a standard television picture signal which would normally be obtained from a live camera chain, film chain, or microwave source as it goes through the processing required to have it recorded on video tape and then played back for previewing or air transmission. Fig. 5 is a simplified block diagram of the video signal path. In the "record" mode a video AM signal of approximately 1.4 volts peak-to-peak is applied to the input of a multivibrator type modulator whose normal rest frequency (4.75 mc.) is made to deviate approximately 2 mc. by variations in the video voltage. The output of this modulator is now an FM signal whose frequency is proportional to the original video amplitude. This FM signal is further amplified and applied, through four identical drivers, to the video record heads on the drum assembly. The signal is then laid down on the tape as previously explained. In the "playback" mode the servo control system insures that each head will follow closely the tracks that have been recorded and the sequenced, overlapping outputs of these heads are fed to individual preamplifiers and into the switching system.

The "switcher" is a fairly complex electronic device capable of precisely sequencing the FM signal from the tape in such a way that no overlap or absence of signal occurs and that switching transients are timed by horizontal sync and do not appear in the picture. The now continuous FM signal is then channeled through a demodulator chassis which applies considerable amplitude limiting (to make up for variations in head outputs). The signal now has a constant amplitude and is applied to a delay-line slope detector and a full-wave rectifier where it is converted back to an AM video signal. Although the output of the demodulator can be used to provide high-quality television reproduction, the degradation of the sync signals is such that the composite video would not meet FCC requirements for commercial re-broadcast. To overcome this deficiency a processing amplifier, somewhat similar in action to stabilizing amplifiers used by television stations, is utilized. The processing amplifier regenerates new blanking signals and amplifies, clips, and gates synchronizing pulses. The newly blanked video is combined with the noise immune, as well as cleaned up sync signals and the resultant composite video output is now acceptable for standard transmission.

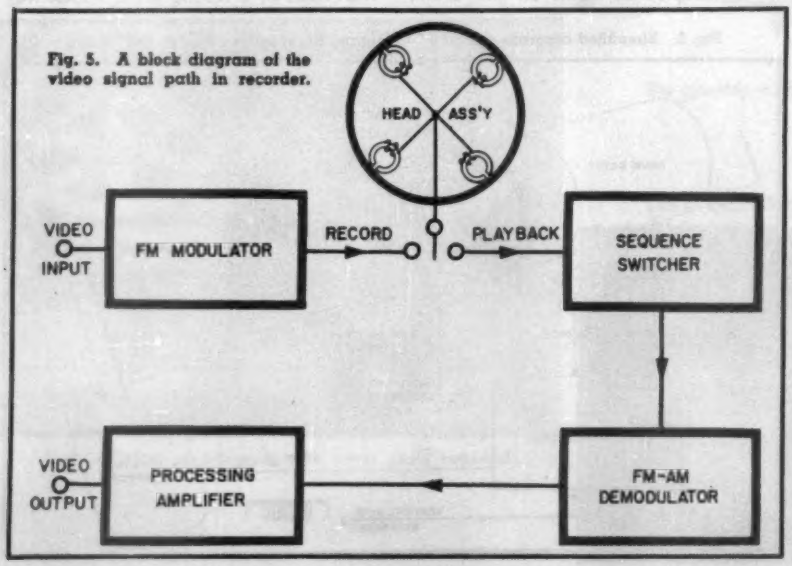
Because of the inherent linearity of the system there is no expansion or compression of the gray scale and the reproduced images are almost indistinguishable from the original on the home receiver. The over-all bandwidth allows an off-the-tape picture of better than 400 lines resolution with a standard monoscope pattern to be played back. The major limiting factor in video tape recording today is the maximum signal-to-noise ratio that can be achieved. At the present state of the art, between 33 and 36 db of signal-to-noise appears to be the maximum. This permits commercially acceptable third-generation copies (a copy of a copy of a copy).

At the present time, to make high-quality copies it is necessary to utilize the original tape feeding a group of "Videotape Recorders" in parallel, each of which is recording the duplicate on a one-to-one time basis. Network tape centers equipped with batteries of these recorders are located in New York, Chicago, and Los Angeles as well as at independent stations all over the world. Foreign stations in Canada, Mexico, Japan, Great Britain, Germany, Australia, and France are using these recorders for day-to-day programming.

The recording of color television signals on video tape, although presenting a much more difficult technical problem, has been successfully demonstrated and its adoption is just a matter of time. A group of *Ampex* VR-1000's has already been converted by *NBC* engineers to record and play back its major color shows (Steve Allen, etc.) and the company is now delivering color conversion kits to its "Videotape Recorder" customers.

A tremendous variety of non-broadcast uses have been opened up by video tape recording. At the AMA convention in San Francisco, in co-operation with *Smith, Kline and French* whose color facilities were being used to telecast surgical operations, color recordings and repeated playbacks served to demonstrate the potentialities of the medium as a medical training tool. The applications of video tape recording to educational and closed-circuit work are being expanded while modified versions of the technique are finding gradual acceptance in the instrumentation field. —30—

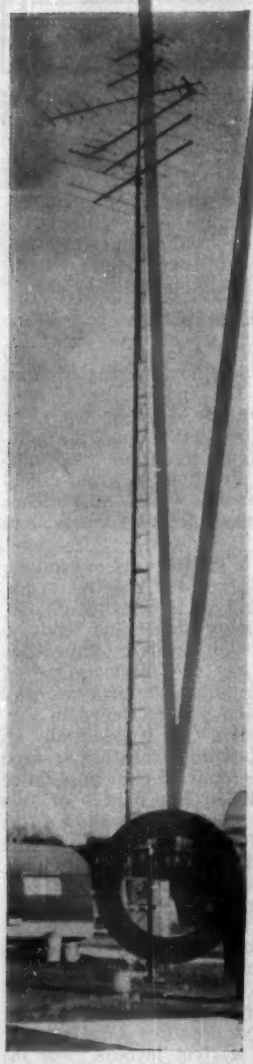
Fig. 5. A block diagram of the video signal path in recorder.



Multi-Set TV Installations: PROBLEMS & PRINCIPLES

By **JACK BEEVER**
Jerrold Electronics Corp.

Part 1. These profit-makers can be handled by small independents. Here is the necessary background.



MULTIPLE-TV systems, in which one antenna feeds up to 1000 sets, are becoming a definite part of the American scene. There are, at present, at least 100,000 such v.h.f. systems in use. Of special significance to the average service technician is the fact that a very large number of these are not complex, expensive systems that are beyond the scope of the small service shop.

Many modest systems are now in use in motels, trailer courts, hospitals, smaller multiple dwellings, and even in private homes, where it is considered convenient to have several antenna outlets strategically located throughout the house so that a portable TV set can be provided with good signal no matter where it may be used. Such a system is also a valuable asset in a set dealer's showroom, enabling the demonstration of any receiver on the floor to its best advantage.

Despite the encouraging prospect, the lack of real information on the layout, maintenance, and "bugging out" of these systems leaves many technicians out in the cold. In actuality, such a system, once the principles involved are understood, is much simpler to handle than a monochrome TV receiver.

A multi-set TV installation consists primarily of three constituents—an antenna, an amplifier, and the tap-off units. These are all interconnected through a transmission line. The purpose of the installation is to deliver signal from the antenna system to each TV set with the least possible degradation, irrespective of what is happening at the other sets. Any such system can be analyzed into a series of gains (amplification), which are lumped, and losses, which are distributed. Essentially, it is a tree-like structure with trunk and branches having sets attached to the branches, like leaves on a twig. Fig. 1 is a block diagram of such a structure.

If the total of all losses seen by any one set on the branch line is less than the gain of the amplifier, the signal delivered to the receiver input will be stronger than that developed at the input of the entire system. In cases where the antenna develops more than enough signal to drive one set adequately, the surplus signal can be considered as part of the system gain. It may thus be used to reduce the gain requirements of the entire installation.

Transmission Lines

It is important that, over the area being served, signal be carried through suitable transmission lines. Parallel-pair lines, such as 300-ohm twin-lead, have the unfortunate characteristic of radiating comparatively large amounts of the signals they carry. This can result in smear and ghosting caused by bad impedance matching and reception of re-radiated signals by the receiving antennas. Coaxial cables do not radiate significantly and are less affected by surrounding materials. These attributes make such cables the logical choice. Since the greatest losses in a system are introduced by these lines, we must be familiar with them.

One of the most important peculiarities to keep in mind is the fact that transmission lines produce greater losses as we go up in frequency. This frequency discrimination, shown by the figures in Table 1, greatly affect the design of multi-set systems. Loss is stated in decibels per 100 feet of cable, with three types being listed. The most commonly used is RG-59/U, which is about ¼" in diameter. Next in order of use is RG-11/U, ½" in diameter. An in-between size, RG-6/U, is also used. Each of these has a characteristic impedance of 75 ohms nominal, which is

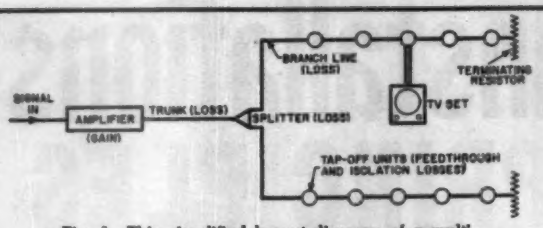


Fig. 1. This simplified layout diagram of a multi-set installation shows all the principal elements.

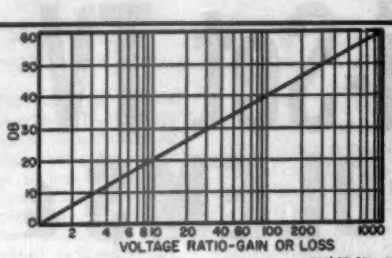


Fig. 2. A graph like the one shown can be used to convert voltage gain and loss ratios into decibels for more convenient system calculations.

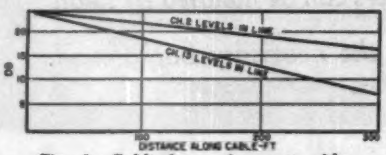


Fig. 3. Cable losses increase with greater lengths and higher channels.

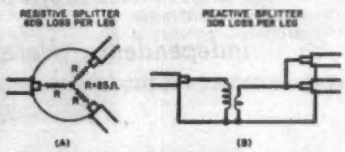


Fig. 4. Line splitters may be resistive (A) or of the reactive type (B).

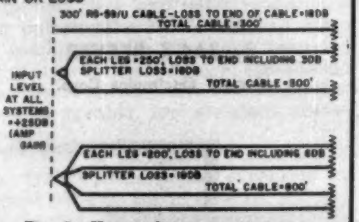


Fig. 5. How splitters can increase cable coverage with a given loss.

practically standard for v.h.f. TV use.

Measurement Units

Use of the decibel in the table brings up another point: it is advantageous to state all gains and losses in the same, compatible terms. Despite the fact that its complex derivation causes many technicians to distrust it, the decibel is the unit that, in practical application, simplifies all calculations.

For convenience, graphs similar to the one shown in Fig. 2 are often used to convert from db to voltage ratios. Values are directly read when dealing with gain. Where loss is involved, the reciprocal of the gain figure is used. For example, 6 db gain is achieved with twice the initial voltage; but −6 db is one half the voltage. Also, a loss of 40 db means a reduction to 1/100th the voltage. For those adept with the slide-rule and owning one with log-log scales, a direct means of conversion is available. The method, involving the *C, D,* and *LL* scales, is described in the "Radiotron Designers' Handbook."

The use of the decibel is amply justified by the great simplification it provides in system calculation. The decibel is based, mathematically, on the common logarithm, which boils down essentially to the exponent required to raise the base 10 to any desired number. Once this operation, a laborious one, has been performed, the functions of multiplication and division are replaced by addition and subtraction. It is important to bear in mind that, when decibels are added, the actual operation is one of multiplication and when decibels are subtracted, the operation is division.

For example, 20 db corresponds to a ratio of 10:1, therefore a gain of 20 db is 10 times, and a loss of 20 db will be a division by 10. Reference to Fig. 2 indicates that 40 db is a ratio of 100:1 and therefore, when gain, is 100 times. If we add 20 db and 20 db we get 40 db. To derive the corresponding answer in arithmetical ratios, we would have to multiply the corresponding ratio of 20 db, thus, $10 \times 10 = 100$. Understanding this relationship allows us to approach a quick estimate of the ratio corresponding to a db number by remembering that a ratio of 2:1 equals approximately 6 db. Knowing this, we can add up sixes until we approximate the number. Each time we add 6 db, we double the ratio.

For example, take 36 db. 6 db + 6 db = 12 db, $(2 \times 2 = 4)$. 12 db + 6 db = 18 db $(2 \times 4 = 8)$, 18 db + 6 db = 24 db $(2 \times 8 = 16)$, 24 db + 6 db = 30 db $(2 \times 16 = 32)$ and 30 db + 6 db = 36 db $(2 \times 32 = 64)$. Thus, 36 db is roughly 64 times. The rule is simple. If you add 6 db, you double the ratio.

This article will always use decibels for *voltage* ratios, which brings up a precaution to be observed. One can only compare the voltage of two points when both points have the same impedance. Amplifiers and coaxial cables commonly used in v.h.f. distribution systems are designed to a characteristic impedance of 75 ohms and the "microvolts" mentioned will be considered to have been read at this impedance, unless otherwise stated. There is a simple, helpful relationship between the voltages at 75 ohms and 300 ohms. The same power is represented at 300 ohms when the voltage is doubled. For example, an efficient matching transformer from 75 to 300 ohms would provide, at its 300-ohm output, double the input voltage and half the input current.

To return to coaxial cable, the important thing which affects its use in systems is the differential loss. Reference to Table 1 shows that RG-59/U has 2.8 db loss per hundred feet at the video carrier of channel 2, while the loss is 5.9 db at channel 13. These figures are rounded out in practice to 3.0 db and 6.0 db. The effect on a system can be readily seen if we assume an amplifier of the broadband type, with a gain of 25 db, feeding into 300 feet of RG-59/U. If the signals of interest are channels 2 and 13, then channel 2 will be dropped 9 db $(3 \times 3$ db) at the end of the line and channel 13 will be dropped 18 db $(3 \times 6$ db). See Fig. 3. Assuming an arbitrary signal level of 25 db to start with, there is a drop to 16 db on channel 2 and 7 db on channel 13. This is a difference of 9 db, or almost three times the voltage. It would seem obvious that the important losses in the system will be the losses of the highest channel. This is the usual rule and, in practice, since one cannot predict what channels will eventually be available in an area, channel 13 losses are used for laying out systems, whether channel 13 is in operation or not.

Line Splitters

It is rare that a system can be laid out with a single line running from an amplifier to the end of the system; as a rule, the line must be "split" or branched. When this is done, the splitting device must maintain impedance match in all directions to avoid reflections and standing waves. Mismatches result in unpredictable levels and ghosts.

Two types of splitters are in common use: the resistive and reactive types. The resistive type, consisting of a *Y* network, is more stable and tends to improve over-all system impedance match, but has the disadvantage of higher loss, usually 6 db for a two-way split. One such unit is shown in Fig. 4A. The reactive type is essentially an impedance-matching transformer used to match the input 75-ohm impedance to the paralleled impedances of two output lines. These devices show a forward loss of 3 db, equal to half the power in each leg. They are, however, dependent for their efficiency upon seeing a good match at all terminals. A basic schematic is shown in Fig. 4B. In reality, in order to get good bandwidth and flat response, these devices are generally more complex and usually have a specified frequency range. The use of these devices produces some peculiar anomalies in system layouts. For instance, the amount of cable coverage by a given amplifier is *increased* when a splitter is used. Fig. 5 helps to illustrate this action and also indicates how a four-way splitter may be used to advantage.

At the top of the illustration, we see signal being fed from an amplifier with 25 db gain to a 300-foot length of RG-

59/U cable. With the high-channel loss of 6 db per 100 feet, 18 db of loss will be incurred to the end of the cable, leaving a signal at the end which is 7 db over the amplifier's input (25-18=7 db). If we take this figure, 7 db, as an arbitrary limiting figure, below which we will not go, we can compare the total footage of cable covered when splitters are used.

The second illustration from the top shows the same amplifier feeding into a two-way splitter, which has a loss of 3 db in each leg. Each cable, therefore, sees a usable gain of 25-3 or 22 db. Since we require that 7 db be left at the end of the cable, then we may lose 22-7, or 15 db, in the cable. Two and one-half times 6 db is 15 db, therefore, each cable can be 250 feet long (6 db loss per 100 feet). The amplifier is now supplying a total of 500 feet of cable, an increase of 40% over the coverage of the single cable. We cannot get farther away from the amplifier, but if the amplifier is centrally located, then we can cover a linear distance of 500 feet, as opposed to 300 feet without the split.

The four-way splitter at the bottom of Fig. 5 has a 6 db loss per leg. This is an increase of 3 db over the two-way splitter, which will reduce the loss we can allow in the branch legs by 3 db. Fifty feet of cable is 3 db of loss and each leg must be 50 feet shorter, making them each 200 feet long. We now have four legs of 200 feet or 800 feet of cable, two and two-thirds as much as the unsplit cable.

Some manufacturers produce asymmetrical splitters, which show different losses to each output. These are sometimes called "matched tapping pads."

Tap-Off Units

The previous discussion points out that the distribution cables from the output of an amplifier contain signals which vary in strength along the cable, being weakest at the cable's ends. If this distribution system is to feed a number of television receivers, it would be better if the sets received signals of approximately equal strength. This imposes restrictions on the design of the tap-off devices. Possibly the best way to describe the functions of tap-off units is in terms of the old, familiar water analogy.

If we consider the distribution cable to be a pipe of fixed bore, carrying a steady flow of water, we can describe the tap-off unit as a faucet tapped into the pipe. If this faucet has the same bore as the pipe and is opened to its fullest extent, one-half the water flow will emerge from the faucet and one-half the flow will continue along the pipe. This would result in the pipe's volume of flow, at a point past the faucet, being one-half the input volume. A similar faucet farther down the pipe would again extract half and this process would rapidly result in very little water emerging from the more remote faucets.

However, if we reduce the flow from the first faucet, the other faucets will have increased flow. By properly adjusting the faucets, we can equalize the flow all along the line. This will result in a condition where the first faucet is almost closed and each succeeding faucet is opened wider than the one preceding it.

We can now relate the analogy to electrical behavior. The closing of the faucet valve is directly analogous to a resistance—so that the tap-off unit must impose a resistance between the line and the load (TV receiver). Such a resistance will cause the voltage developed across the load to be less than the voltage on the line. We can express this difference in db, since the *ratio* will be the same irrespective of the absolute levels on the line. This difference which, from the viewpoint of the receiver, is a loss, is called "isolation loss," since it also serves to isolate the set from the system by the amount of the loss.

To return to the water analogy—the faucet allows some water to escape, reducing the volume in the line. This loss in the line, caused by the insertion of the tap-off unit, is called "feedthrough loss" or "insertion loss." The term "feedthrough" is preferred, to avoid confusion with insertion losses in other applications.

The isolation loss is important for a number of reasons other than that of adjusting the amount of signal taken from the line. It reduces the feedback of extraneous signals caused by TV receiver local oscillators or arcing tuner contacts into the signal line and presents an isolation between any two sets which is the sum of *two* tap-off isolation losses. The isolation also prevents the widely varying input impedances of individual receivers from disturbing system impedances to a significant degree.

We can see that three aspects are important to us in system layout: 1. Feedthrough loss, which appears as a general system loss. 2. Isolation loss, which is seen by the individual set to the system only. 3. Matching of impedances, necessary to maintain system balance.

The function of impedance matching is not always found in the same unit as the tap-off device. In some cases, the tap-off unit will feed its reduced signal to a length of coaxial cable which terminates in a matching transformer. This technique is common where very high ambient signal levels are found and it is necessary to prevent the set from picking up direct signals on its lead wire.

Two methods of tapping a feeder line are generally used; the resistive and the capacitive. These are shown in Fig. 6. In neither case does the output represent a 75-ohm source; but, if the load at the end of the tap-line is a 75-ohm load, no reflections will occur and the system will not be significantly disturbed. It has been found that capacitive taps have a less disturbing effect on the system and these are the usual choice. A matching transformer, for example, will reflect any impedance variation seen at its secondary to its primary, which is what the system sees. Although matching transformers are more efficient under proper conditions, their use is not always advisable.

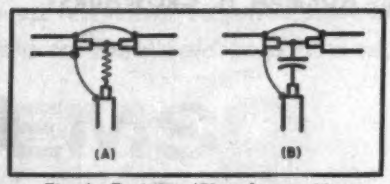


Fig. 6. Resistive (A) and capacitive (B) methods for tapping a feeder line.

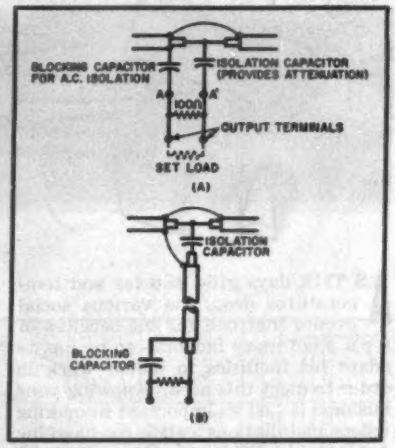


Fig. 7. Typical tap-off configurations: combined type (A) and separated type (B).

A resistor is not generally frequency sensitive. Within limits, 75 ohms of resistance will be 75 ohms as frequency increases until the lead length or the resistor element becomes an appreciable inductance (which should be a warning against using wire-wound resistors). With this in mind, we can see that the load should be as resistive as possible and should be 75 ohms, the characteristic impedance of the cable. A simple circuit is almost universally used as a matching network in these instances. This circuit is shown in Fig. 7. Examination of the circuit shows that the tap-off circuit's 75-ohm output, across points *A* and *A'* in Fig. 7A, sees as a load the 100-ohm resistor paralleled with the nominal 300 ohms of the set. The impedance will therefore always be something less than 100 ohms, approaching the required system impedance. The major component will

(*Continued on page* 145)

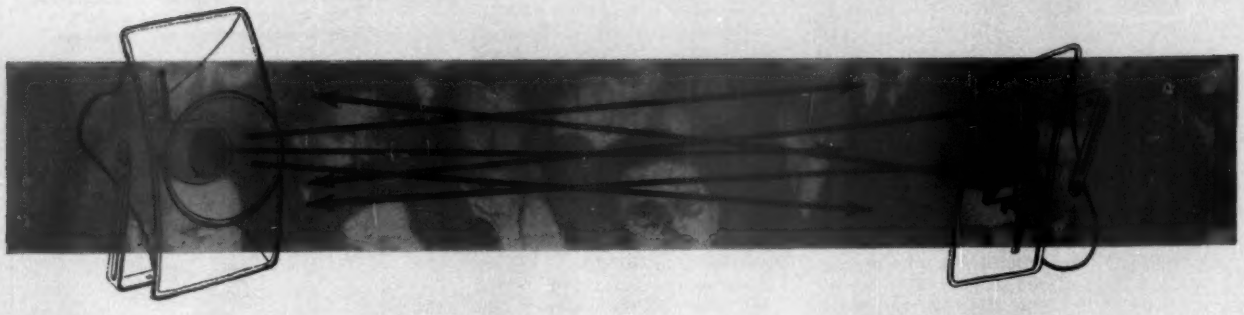
Table 1. Attenuation factors for three chief cable types on v.h.f. channels.

	TELEVISION CHANNELS												
CABLE*	2	3	4	5	6	FM	7	8	9	10	11	12	13
RG-59/U	2.8	3	3.2	3.4	3.6		5.3	5.4	5.5	5.6	5.7	5.8	5.9
RG-8/U	2.1	2.2	2.3	2.4	2.6		4.0	4.05	4.10	4.15	4.20	4.25	4.3
RG/11U	1.6	1.7	1.8	1.9	2.0		2.7	2.75	2.80	2.85	2.90	2.95	3.0

* Cable attenuation in db per 100 feet

By **NORMAN H. CROWHURST**

INDOOR PUBLIC



AS THE days grow shorter and temperatures drop, the various social events that call for the services of a p.a. man move indoors—so he has to adapt his facilities to indoor work in order to meet this need. Knowing your business is just as important in making indoor installations as it is for handling outdoor jobs. The same questions have to be answered: "How many and what kind of microphone? How many, what kind, and where to put the loudspeakers. How many watts and what features does the p.a. amplifier need? Are any other facilities required?" The answers to such questions can be quite different from those pertaining to outdoor jobs.

In the outdoor department, microphones have to be chosen for ruggedness and for the ability to pick up despite a wind. Although these are not problems encountered in microphones for indoor installations, we have dissimilar but equally important problems. Indoors the big concern of sound re-inforcement is getting sufficient amplification without acoustic feedback or "howlback." To get best results in this direction, care must be exercised all along the line—microphones, amplifiers, accessory units, and loudspeakers.

Microphones

As a general rule, the best microphone for such indoor p.a. applications has a directional response—cardioid or "variable D"—and the smoothest possible frequency response. But this rule, too, has exceptions. In some indoor installations the acoustic reverberation characteristic of the building may be very "peaky" due to the building structure—use of paneling, glass, or tiled surfaces, etc. Sometimes a microphone that would be bad anywhere else turns out to be good in this particular building because the peaks in the microphone response just happen to avoid those produced by the building acoustics.

One such case occurred recently. Testing microphones side by side, a high-quality cardioid definitely gave the most natural reproduction of individual voices, but a microphone that sounded quite harsh, because of its peaky response, could have the volume turned up so both intelligibility and apparent loudness were better, although the quality was not as natural. The decision went to the lower quality mike for this particular job. In a different building quite different results might have been observed and another "bad" microphone might have proved to be the best.

If you have, or are prepared to buy, a variety of microphones and are likely to have the opportunity to try them out on each indoor job you get, you may find that such inferior quality microphones will accidentally suit the job at hand. The approach is a little more tedious, but sometimes worthwhile. However, often this approach is impractical since there is no opportunity for testing a number of microphones ahead of time.

A better and surer approach is to use the best microphone of the type suited for the job and a flexible amplifier that will make the best of the acoustic problem. By suiting the microphone to the job, we mean choosing a directional pickup pattern to suit the type of program material to be presented.

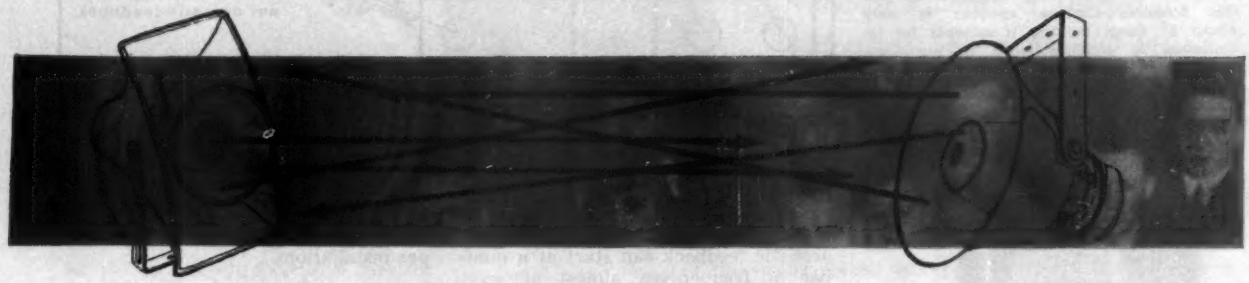
For a single voice pickup, the cardioid is usually best—although a ribbon (gradient or velocity type) often does as well. For a small group that can conveniently get "in front of" a cardioid, this type is also very satisfactory.

For larger pickup areas, such as an orchestra or dramatic presentation, more than one microphone is needed. American practice favors pressure units, usually dynamic, for this purpose. European practice leans toward the use of ribbons carefully placed—and the results often validate the claim of its superiority made by the proponents of this method. This latter technique is somewhat more fussy to use since you not only have to get the microphones in the right places but they must be oriented correctly. Dynamic types, correctly phased, can be used close together but it is always best to keep ribbons spaced well apart, consistent with proper coverage of the required pickup area.

Here is an integrated indoor sound distribution system, recently announced by DuKane, that also includes closed-circuit TV, emergency alarms, along with timing circuits.

Planning and setting up a system requires special know-how. Here's help for the would-be p.a. man.

ADDRESS SYSTEMS



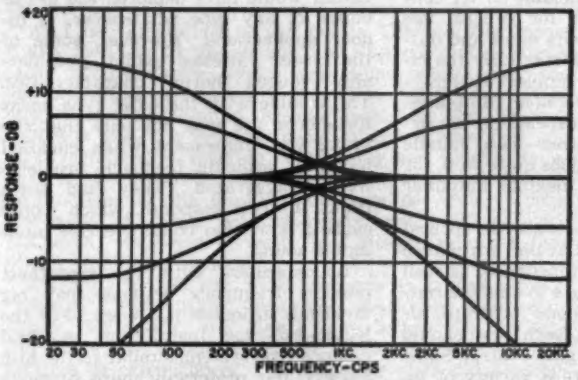


Fig. 1. Here are typical frequency response changes that are produced by the tone controls in a high-fidelity amplifier.

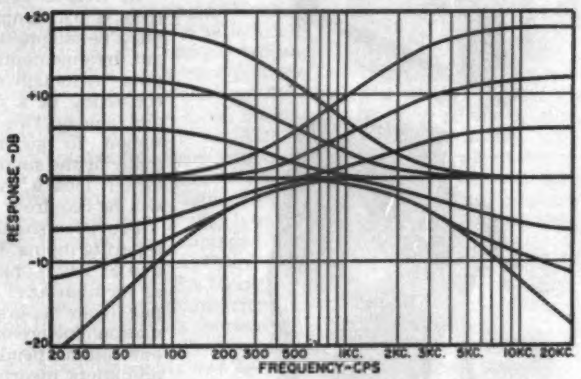


Fig. 2. Shown here are the response changes that would provide more suitable control in a public-address amplifier.

Where two or more microphones are needed, due to spacing considerations, better operation can be obtained by arranging to have only one, or a minimum number, "live" at one time. For example, a platform mike for the chairman, with another at the front of the auditorium, may be used for interviews. A quick-fade device, so only one mike is "on" at a time but fixed so that changeover can be made as quickly as the dialogue alternates, will enable a better "howl-free" level to be achieved. The operator cannot read the "funnies" during this kind of program, but the improved results are well worth his extra attention.

Of course there are simple "mechanical" things about choosing the correct microphone, such as making sure its impedance is right and the plugs fit the amplifier input sockets—or at least that you have the necessary adapters.

Choice of impedance is not merely a matter of matching microphone to amplifier. If the microphone is always near the amplifier, so a short connecting cable (not more than 10 to 15 feet) can be used, then impedance is unimportant, provided you match. If, on the other hand, you anticipate using longer input runs, it is worth investing in microphones that use a line impedance (150, 250, 500, or 600 ohms) and an amplifier with line input transformers to match, either internally or externally. If external transformers are used, watch your connections to maintain complete shielding and grounds.

Another mechanical detail is that of shock mounting. The indoor mike faces no problem of wind, but it often meets one involving the transmission of vibration from the floor on which it stands. In a bad case, where a vibration mount proves inadequate, the solution may be to suspend the microphones by cables from suitable high points. One disadvantage of this method is that the right position must be carefully determined in advance since it may prove difficult or impossible to make changes during a program.

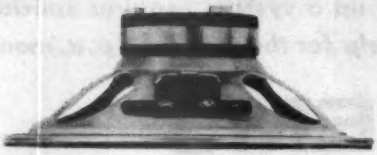
Amplifiers

The use of an amplifier designed for the purpose can go a long way toward improving the performance of an indoor p.a. system. Convenient controls for individual microphones to facilitate the quick-fade method of operation, a comprehensive tone control arrangement, and possibly an anti-feedback device, can all contribute to more effective amplification on difficult jobs.

The luxury way to do the job is to use a separate microphone preamp for every mike, each with its own tone-control circuit so that performance can be individually optimized. The outputs of these preamps are then fed into separate high-level inputs on the main amplifier and the controls on these inputs used for quick-fade operation. For a truly "deluxe" system, the controls could be remotely operated by using electronic gain and tone controls —but such units are not commercially available.

Tone controls for p.a. work should provide a different form of response variation than that usually incorporated in high-fidelity amplifiers. In a hi-fi amplifier the main purpose of such controls is to adjust for deviations in the quality of the program source. For p.a. purposes the controls have to adapt the performance of the system to the acoustics of the hall or auditorium. The usual response variation of a hi-fi system is shown in Fig. 1 while Fig. 2 shows the desirable characteristics for a p.a. system. The object is to adjust the relative level of different parts of the audio spectrum.

The usefulness of an anti-feedback device, consisting of an adjustable rejection circuit, depends on the location. If acoustic feedback occurs at one very



Although not specifically designed for p.a. this Stromberg-Carlson speaker is only about 3" deep, making it suitable for installation in shallow walls or partitions.

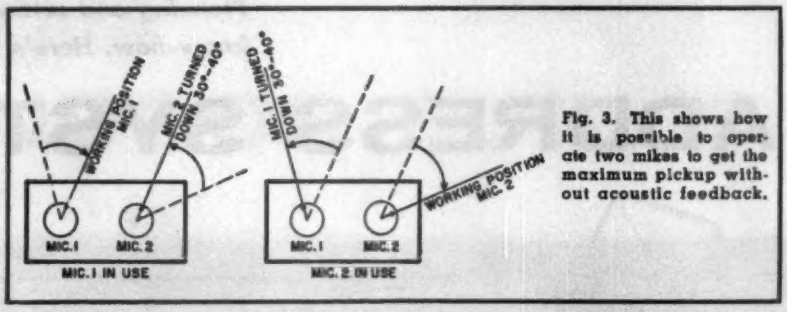


Fig. 3. This shows how it is possible to operate two mikes to get the maximum pickup without acoustic feedback.

Many p.a. speakers, such as these by Electro-Voice, may be used indoors or outdoors.

In temporary installations the speakers may be installed on heavy-duty supports, such as this Atlas telescoping stand.

definite frequency, use of a filter adjusted to this frequency will enable the gain to be turned up much farther before acoustic "howlback" is encountered. In many buildings, however, acoustic feedback can start at a number of frequencies, almost at once. Eliminating the one that happens first will then give very little margin.

As well as being flexible in its controls a p.a. amplifier for general use must be adaptable in its input and output arrangements—particularly the inputs. Although the simplest system—consisting of a microphone, amplifier, and one or two loudspeakers, all designed to go together—can handle many of the smaller jobs quite well, for larger jobs a more flexible amplifier will be required.

Provision should be made for several separate inputs, both at line impedance and at low or high impedance, as well as for high-level inputs to suit the output from tuners, phono preamps, or microphone preamps. Each input should have an independent gain control. Some amplifiers incorporate a variety of input sockets which may be selected by switch, using the same gain control for all. Although the best way of operating is to keep only the active circuit of the moment "live," it is not too practical to switch live input circuits. For one thing, it may produce quite objectionable plops and, for another, the level invariably needs to be adjusted. The gain control must have its setting changed simultaneously with each change of switch position which can be a difficult and confusing operation. The better way is to get an amplifier with the necessary number of multiple inputs and individual controls for each.

If the operation of the controls, using this method, calls for considerable rotation from "off" to the desired setting, a simple trick during an interview is to turn the "off" mike down only a few degrees. It will still be "live," but it will not contribute to possible feedback while not in use. Then you can follow changes from one mike to the other merely by turning the two knobs about the same angle of rotation in opposite directions—a very easy operation to do quickly and repeatedly without confusion (see Fig. 3).

Of course the amplifier must have sufficient power for the job. This is less often a problem in indoor installations than in outdoor jobs where sound "gets lost" so easily. Usually the problem with indoor p.a. systems is one of controlling the sound rather than getting enough of it. In larger indoor jobs or where there are tie-ins with other buildings, more than one amplifier is needed, but that is getting into the bigger installations.

Loudspeakers

As for loudspeakers, at one time the author would have deplored the use of horns, of any type whatsoever, in indoor applications. However, some of the newer varieties exhibit considerably reduced "horny" characteristics. The trouble with the older type horns for indoor use was not only that the sound was unpleasant when enclosed but that acoustic feedback problems were exaggerated. They had some peaks in their response, which would cause a howl that could override intelligible sound.

Loudspeakers with the smoothest possible frequency response pay big dividends in indoor p.a. work. For the legion-hall-type installation, a good cabinet type system, similar to the hi-fi variety, but preferably more ruggedly built, will give results that justify its increased cost. In fact, two loudspeakers of this type, one on each side at the front of the hall, will often do a better job than many more smaller units distributed around the place. So, in this case, the more expensive units do the least costly job in the long run.

In some buildings, however, it is not practical to use such a simple loudspeaker installation. Odd corners would not be served with sound, so extra units are necessary and often these must be compact due to space limitations. This is where some of the newer wide-range composite horns prove useful. They are compact and give smooth, extended-range reproduction.

For outdoor installations the loudspeakers have to cover audience *area*, but indoors it is often more a question of *volume*, with due attention being paid to relative reverberant effects. A problem that poses typical variations is a movie theater, disused for its original purpose, in which p.a. or sound reinforcement is required. A single group of loudspeakers cannot be clumped together at the former site of the screen because this would feed them right into the mikes. They have to be installed at the sides despite the fact that they will not cover the entire audience area as well. See Fig. 4.

(*Continued on page* 112)

Service Holds a Convention

By **SIDNEY C. SILVER**
Service Editor
RADIO & TV NEWS

National Alliance of Television & Electronic Service Associations meets in Chicago. An editor's impressions in an open letter.

Mr. Frank J. Moch, Executive Director
NATESA
5908 South Troy Street
Chicago 29, Illinois
Dear Frank:

As I had mentioned to you out in Chicago, the opportunity to sit in on the annual NATESA convention was a most rewarding one. There were some points along the way when unpleasant doubts almost spoiled the fun. Happily, these were resolved, by and large. The final impression was one of a vigorous group boasting an active and alert membership, meeting controversy and touchy issues head on, letting all be heard who wished to be heard. Your own actions at the final session were particularly commendable. A check with observers, not affiliated with NATESA, who were present in Chicago indicates that others share this opinion.

Attempts to deal with such problems as captive service, "inboard" warranties, licensing, marketing, tube-sale abuses, set safety, and others were impressive. So was the long-range planning evident in the handling of such matters as expansion of the manpower pool and development of an educational degree for technicians. We look forward to saying more about these matters as your committee reports become available in the future.

We also enjoyed observing a vigorous, old-fashioned election, concerning which we report further in "Service Industry News" this month. The attempt to answer questions involving the internal organization of NATESA, posed by non-affiliated persons, was also reassuring.

As for those unpleasant doubts: although resolved, they are worth raking over because they contain constructive lessons for all of us concerned with the future of the service industry. Largely, these doubts involve the early attitudes shown toward press coverage of the convention and toward questions concerning the internal organization of NATESA posed by unaffiliated persons.

Let's go back to a few weeks before the convention. Frank Teskey, editor of "The Hoosier Test Probe" (Indianapolis Television Technicians Association), had sent you an exhaustive set of questions covering organization, control, and finances of NATESA. He would like answers, he felt, before he could recommend NATESA affiliation to his own group or other related ones in the state-wide Indiana Electronic Service Association.

Although Teskey himself did no trumpeting, RADIO & TV NEWS was able to obtain copies of the queries from a secondary source. To avoid a one-sided picture, we asked you for your answers, for publication. However, you felt that many of the questions had the loaded flavor of "When did you stop beating your wife?" Others, you believed, involved matters privy only to NATESA and its members. No matter how innocent these matters, you felt, disclosure to outsiders might be turned to work against the best interests of the national group. To these, the only answer you considered practical was, "None of your business until you join." Since honoring the questions as a whole would only provide grist to the mills of NATESA opponents, you felt the wisest course would be for NATESA to stand on its prerogative as a corporate body and ignore the questions altogether. You also suggested that publication of the questions would not be in the best interests of service. Even acknowledging a certain amount of logic in this stand, we were not wholly satisfied.

Arriving in Chicago, we soon heard another unhappy note struck. However politely it was done, we were informed that we would not be permitted to attend regular business meetings from the outset. Nothing personal, you hastened to assure us. Until a couple of years ago, the conventions had been wide-open affairs. Then along came an observer for another publication, you told us, who sat down among you, listened quietly, and went home to cover the meetings in a way you felt to be so unfair that the organization was damaged by his story.

Also excluded was Frank Teskey. Regarded as a member of the anti-NATESA forces, he might use the floor to snipe and to disrupt, to interfere with the normal completion of the convention's pressing business, you feared.

At this point, a first impression was beginning to form: As some opponents had been shouting, NATESA looked as though it could indeed be run by a band of arbitrary thugs, working out of public view as much as possible, secretly, in the dead of night.

Now we sought out Frank Teskey. From him we learned several things and formed more conclusions. We were convinced of his personal integrity. We also discovered his own position. To begin with, he was sold on the idea that national unity is absolutely essential. Also, although he knew that NATESA is not now the single undisputed instrument toward that goal, he believed it was as close as any organization had come or is likely to come. For this reason, he felt that the immediate objective should be reconciliation of all service people within NATESA.

So convinced was he on this point that he was actually going about trying to sell the same attitude to representatives of other groups still withholding affiliation. In effect, *he was drumming up potential NATESA members!*

Part of his campaign involved accumulating all the reservations he could from as many hold-out groups as he was able to contact. It was from this effort that his exhaustive composite of questions grew. His hope was to resolve all doubts once and for all. After his exclusion, he appeared to feel no anger. Instead he felt that he may have himself been largely responsible by an inadvertently undiplomatic presentation, for having antagonized NATESA. He was ready to return home, his mission a failure, to concentrate on local activities.

Let's assess what had *almost* happened up to this point. The chief vehicle through which non-NATESA people must learn of your organization, the industry press, had been left with a disappointing impression. A sympathetic outsider was ready to turn away, for the time being, from the national group that must look to people like him for its long-term growth and strength. All this in the presence of representatives of other unaffiliated groups, including

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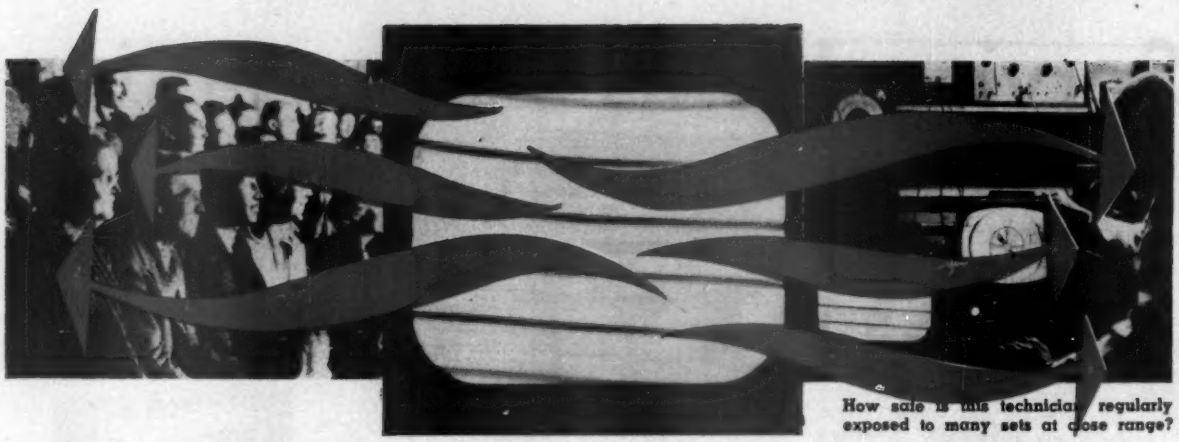

How safe is this technician regularly exposed to many sets at close range?

X-RAYS from TV Sets: Are They Harmful?

Do viewers and technicians have a real cause for worry? What bearing does prolonged exposure have?

By **CHARLES R. MADUELL, Jr.**

EDITOR'S NOTE: *Data on possible harmful effects of x-radiation from TV receivers has been as scarce as questions on this subject have been plentiful. The author is well equipped to shed needed light; he has been trained as a physicist; he services TV and other electronic gear—including medical electronic equipment; he has access to the required measuring equipment; and he knows how to use it.*

THERE have been many statements and questions of late concerning the x-rays that may emanate from television picture tubes. To evaluate the situation, there must be some understanding of what is involved.

First, it might be advantageous to describe how x-rays are produced, what they are, and how they act. They are actually electromagnetic rays, similar to radio waves, but of extremely short wavelength. As such, they travel at the speed of light. Their effects, production, and transmission through media such as glass, metals, the human body, etc., bear some relation to the action of radio waves or light radiation.

X-rays are produced within the atom. When high-velocity electrons, such as those produced from a hot cathode and accelerated by a high voltage, are made to hit a target, x-rays result. Of course, in any x-ray tube, most of the high energy of the electrons is dissipated in the form of heat and less than one per-cent actually penetrates the atoms of the target material to change the energy into x-rays. See Fig. 1A. A very complicated part of the electron theory is used by physicists to describe how high-energy electrons lose their energy to an atom, making the atom give off x-rays. It is not important to go into detail here, except to state that there is a definite relationship between the voltage across the x-ray tube (giving the electrons their high velocity and therefore their high energy) and the wavelength of the x-rays produced. In medicine, x-rays produced by electrons accelerated at from 15,000 volts upward have medical value and pathological effects.

The so-called "soft" x-rays are produced by electrons which are accelerated by voltages of from 15,000 to 30,000 volts. X-ray equipment for "picture taking" is usually shielded in such a manner that these soft rays rarely leave the instrument. The x-rays used for picture taking are accelerated by voltages which vary from 30,000 to 125,000, the latter figure being the present upper limit of x-rays for medical picture taking. Higher voltages are, however, used in x-ray therapy (treatment), as high, in fact, as one-million volts. In industrial x-ray instruments, voltages on the order of hundreds of thousands of volts are employed, but such equipment has been replaced to a great extent by spontaneous atomic radiations from isotopes, which is another subject!

In general, however, x-rays can be produced by high-energy electrons hitting any material, be it a metal target or the screen of a television set. It is a fact, therefore, that perhaps one percent of the electron energy that produces the picture on the television screen makes the screen material give off x-rays of the so-called "soft" variety of from 15,000 to 30,000 volts. Compare Figs. 1A and 1B. This has given rise to needless worry which can best be dispelled by examining the problem.

The penetrating power is directly related to the wavelength (and therefore the voltage) of the x-rays. An x-ray technician selects a higher kilovoltage to penetrate a stout person than for a thin person, and to penetrate a chest than would be used on a hand. The quantity or density of x-rays, however, is dependent on several factors which we will now examine.

First, x-rays behave much like radio waves emanating from an antenna. If a greater r.f. current is fed into the antenna, more radio waves will be given off. Similarly, if a higher current flows through an x-ray tube, more x-rays are given off. The quantity or density of the x-rays produced at the screen of a television picture tube is directly related to the current through the tube itself; and penetrating power or hardness to kilovoltage.

In an x-ray tube, the electron beam is focused on a very small target area at a current of several hundred milliamperes. Such x-rays are of high density and heavily concentrated at a single spot. In a television picture tube, on the other hand, the current is from a few hundredths to thousandths of that used in an x-ray tube (100 μa. compared with 50-500 ma.). Although the beam is focused on a similar small spot, the spot is scanned, hence, the small amount of x-rays produced are distributed over the entire screen area. See Fig. 2.

The second factor affecting quantity is time. If two drops of water per second are allowed to drip into a glass and two hundred drops per second from a second faucet into another glass, if the first faucet dripped for 100 seconds and the second faucet for one second, at the end of the experiment both

glasses would contain the same amount of water.

In the case of a television picture tube, although the current is rather low, the instrument is on for many hours at a time. On the other hand, an x-ray machine, with its high current, is usually on for only a small fraction of a second. Simple arithmetic will show that a television picture tube operating at 30,000 volts with a current of 100 μa., will produce the same quantity of x-rays in an hour as an x-ray generator using 100 ma. and operating at 30,000 volts will produce in slightly more than 3½ seconds.

The quantity of x-rays is dependent on several additional factors, two of which are very important to us. The first factor is distance. X-rays, just like light or radio waves, travel in straight lines. They can, however, be deflected by intervening objects but not to the extent that light or radio waves can be deflected. They do, however, suffer a loss which is governed by the so-called "inverse square law."

An x-ray beam has one fourth its strength at double the distance, just like radio waves. Therefore, to produce the same effect four feet from the tube as was originally produced at two feet, the quantity (amount) would have to be increased by four (by increasing the current through the tube four times or by quadrupling the time). The viewing distance for a television picture is two to three times that involved in taking x-ray pictures but is many times the distance in x-ray therapy, where the tube is often almost in contact with the part being radiated.

What is of most importance, however, is the relative absorption of x-rays through materials. It is known that in so-called "Grenz ray" therapy, 15,000 to 30,000-volt soft x-rays are used. In order to get these x-rays out of the tube, it is usually necessary to have special tubes constructed with extra thin glass or beryllium windows.

Grenz rays are used in surface therapy, in treatment of skin diseases, and occasionally in cases of internal injuries involving areas near body orifices through which the tube can be inserted. These rays are heavily absorbed by surface layers of body tissue and do not penetrate much beyond the skin.

In an x-ray machine of the standard radiographic type, practically all the radiation of less than 30,000 volts is filtered out through the glass of the tube and the oil in the tube housing. Whatever remains is usually filtered out by 2 mm. of aluminum in the form of a small aluminum plate less than 1/10 inch thick placed directly in the path of the x-rays.

X-rays are absorbed in what mathematicians call an "exponential" fashion. If a filter 1 mm. thick absorbs 90 per-cent (transmitting 10 per-cent) then a 2 mm. filter of the same material will not absorb all the rest but will absorb 90 per-cent plus 9 per-cent, or 99 per-cent. This brings us back to our original point concerning TV set radiation.

The glass on a television picture tube is fairly thick, in fact it is ten to fifteen times thicker than the glass in the window portal of an x-ray tube. Since soft x-rays are more easily absorbed than hard and since the x-rays produced in a television picture tube are all of the soft variety, only extremely small amounts of x-rays would reach the outside of the glass. See Fig. 3. Even these would probably be completely lost in the safety glass and the wood or metal cabinet of the instrument.

Experimental analysis indicates this to be true. An "R" meter chamber (used for measuring x-rays for therapy dosages) was taped to the front of a television picture tube and left there for several hours. The x-ray-producing (and light-producing) electron beam was less than an inch away but no measurable radiation was indicated on the "R" meter.

A somewhat different situation was found, however, when the same experiment was tried in the high-voltage cage near the rectifier tube. These tubes are constructed with thin glass envelopes and therefore some x-rays should be measurable. We discovered that a reading taken one inch away from the 1B3 tube operating at 16,500 volts indicated .01 roentgen unit of x-rays per hour.

In a TV service shop where from 5 to 10 sets are on all day, a radiation detector chamber placed less than 10 feet from the sets indicated approximately .05 roentgen (50 milliroentgens) of radiation in one month. This is not much more than the normal background count, due to all sources of radiation, in many parts of our country. Thus it can be stated that no appreciable x-rays were found in the TV service shop checked by the author.

The radiation standard adopted for the guidance of x-ray personnel specifies that exposure to no more than 100 milliroentgens per week comes within allowable limits. A hand placed within the high-voltage cage near the 1B3 would receive this dosage in ten hours. Since no one would willingly place his hand in the high-voltage cage for even one second with the power on, the radiation "hazard" is virtually nonexistent. No sane person would take such a chance with the voltages involved, let alone the radiation.

If you are still worried about radiation from your TV set, here is a simple and inexpensive test that should convince you. Purchase a small dental x-ray film from your dentist—he might even give it to you. Place a paper clip on the edge of the film. Place this film in the high-voltage cage of your TV

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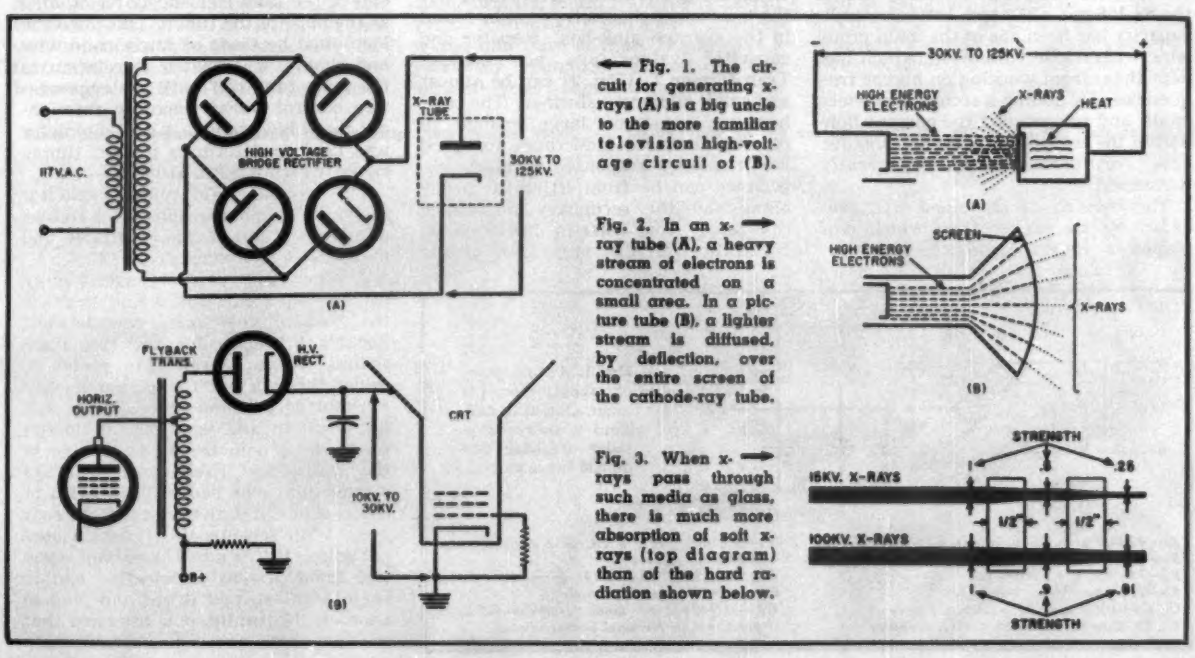


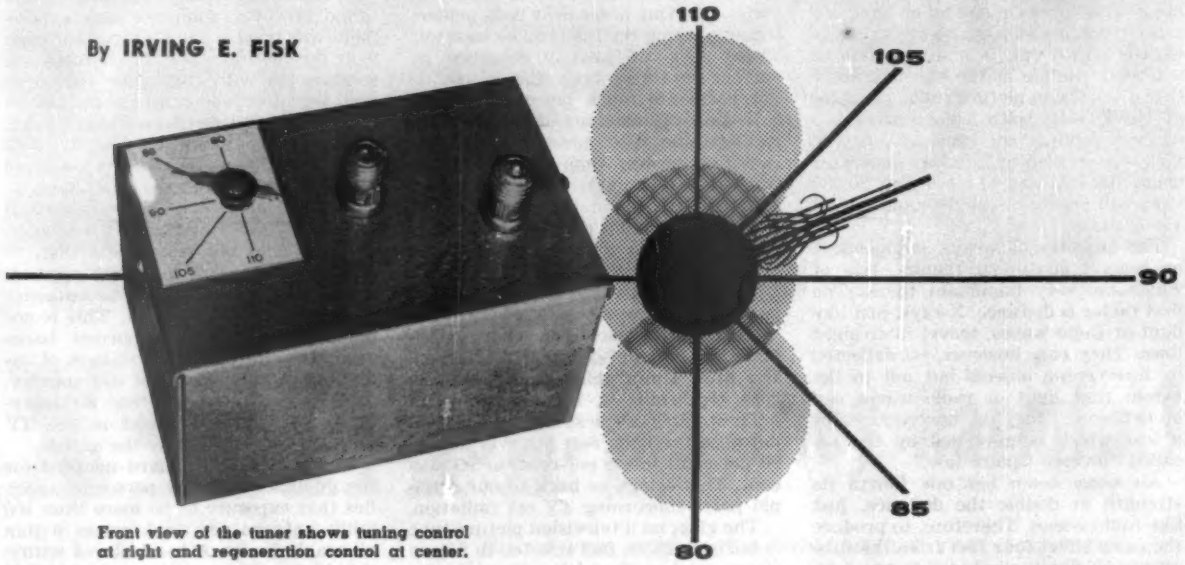
← Fig. 1. The circuit for generating x-rays (A) is a big uncle to the more familiar television high-voltage circuit of (B).

Fig. 2. In an x-ray tube (A), a heavy stream of electrons is concentrated on a small area. In a picture tube (B), a lighter stream is diffused, by deflection, over the entire screen of the cathode-ray tube. →

Fig. 3. When x-rays pass through such media as glass, there is much more absorption of soft x-rays (top diagram) than of the hard radiation shown below. →

Transistor Superregen FM Tuner

By **IRVING E. FISK**



Front view of the tuner shows tuning control at right and regeneration control at center.

New tetrode transistor and use of slope detection result in a simple, battery operated tuner unit.

TWO years ago this tuner couldn't have been built! The upper frequency limit of readily available transistors was about 2 mc. and they were still in the $5.00 price class. The 3N25 *Texas Instruments* tetrode transistor used in this FM tuner has an *alpha* cut-off of 250 mc. and yet costs only $12.50. This is the only critical and expensive item in the entire circuit.

The 3N25 has a gain of 10 db at 100 mc., hence is well suited to use in the 88-108 mc. FM band. Interelectrode capacity has been one of the main problems with triode transistors which has kept them from working on higher frequencies. By adding a second base electrode, and so confining the current flow within the transistor to a much smaller area, this problem has been greatly minimized.

The unit to be described was preceded by an earlier type which employed a separate quench oscillator. This design was abandoned in favor of the circuit shown in Fig. 2 because it was too touchy to operate and required more expensive components.

Construction

A chassis box measuring 4" x 6" x 3" was used as no attempt was made to miniaturize this tuner. A transistor superregenerative receiver will radiate just as its tube counterpart so a metal enclosure is advisable. Everything but the transistors themselves can be found in the average junk-box. Resistor and capacitor values are not critical. Transformer T_1 (Fig. 2) can be almost any small audio transformer. The core, however, must be large enough to provide adequate inductance for good low-frequency response. Primary impedance can be from 10,000 to 20,000 ohms and the secondary impedance can range from 5000 to 10,000 ohms. Naturally, the d.c. resistance of the primary mustn't be too high with only a six-volt power supply. Any one of several types of *p-n-p* audio transistors may be used in the second stage.

The usual v.h.f. wiring precautions must be observed. All leads in this portion of the circuit must be as short as possible.

Antenna coupling with a superregenerative receiver is notoriously touchy. A one-turn loop is positioned at the cold end of the tank coil and is terminated at the back of the tuner. This one-turn loop must be made of fairly rigid wire and should be adjusted in relation to the main tank coil until the regeneration control works smoothly throughout the tuning range. A grid-dip meter was used to determine the *LC* tuning range, which is 82 to 110 mc.

The two-gang FM tuning capacitor shown in the photographs is, of course, unnecessary but it was available and inexpensive so it was used.

Another 3N25 could be added as an r.f. amplifier but this would increase the cost of the tuner considerably. Sockets are used for the two transistors. Some of you may prefer to solder them in but the author doesn't recommend this procedure. If you solder them in and your circuit doesn't work and if you trace the trouble to the transistor itself—you'll always wonder if it was bad to begin with or if you ruined it with the heat from your iron. With sockets, this question does not arise. If it is a bad transistor—you will know it was a defective one to begin with—so pull it out and plug in another. Naturally, it is assumed that the rest of the circuit has already been

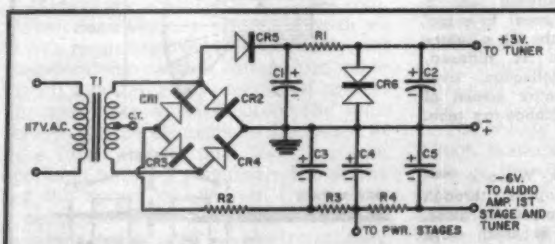


Fig. 1. An a.c. power supply for FM tuner. Output is sufficient to power transistor amplifier and an AM tuner as well.

R_1—47,000 ohm, ½ w. carbon res.
R_2—100 ohm, 2 w. carbon res.
R_3—75 ohm, 2 w. carbon res.
R_4—200 ohm, ½ w. carbon res.
C_1, C_2—1000 µfd., 15 v. elec. capacitor
C_3, C_4, C_5—500 µfd., 15 v. elec. capacitor
T_1—Fil. trans. 12.6 v. c.t. @ 2 amps (Stancor P-8130 or equiv.)
CR_1, CR_2, CR_3, CR_4—1N91 germanium diode
CR_5—1N34 germanium diode
CR_6—1N471 Zener diode (International Rectifier Corp. or National Semiconductor)

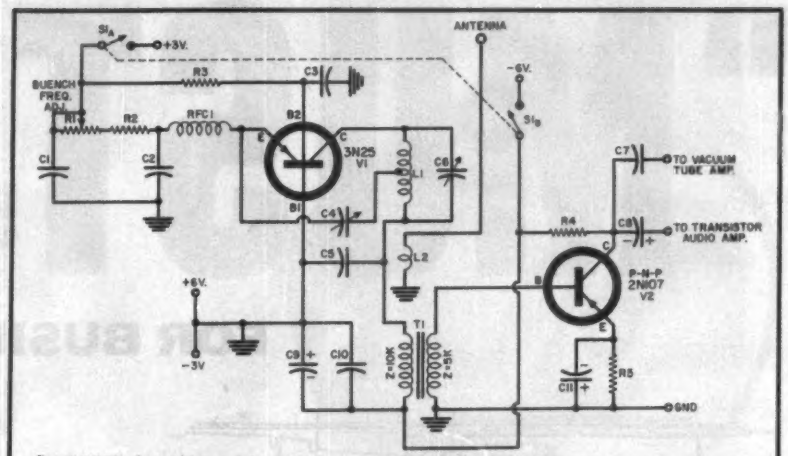
checked for excessive voltage and/or current drain.

A four-terminal *Cinch-Jones* barrier strip may be seen at the rear of the tuner. Two terminals are for the antenna input and two for the external negative six-volt power source. The positive three volts is obtained from two of the large penlite cells connected in series. These are mounted inside the box and are visible in the upper right-hand corner. Current drain from the six-volt supply is 400 μa. and from the three-volt supply is only 300 μa. Under normal use, the batteries should last about a year. If a nine-volt battery is available, and can be tapped at six volts, the power supply can be made more compact. Just ground the six-volt tap and you have a negative six-volt and a positive three-volt source in one package.

An a.c. power supply is shown in Fig. 1. This provides plenty of current to power a good transistor amplifier, such as the one described by Paul Penfield, Jr. in the August, 1956 issue of RADIO & TV NEWS, plus this FM tuner, and perhaps a regenerative AM transistor tuner as well. Just such a set-up as this is being used daily by the author and has been for several months.

Three six-inch PM speakers with their 8-ohm voice coils connected in series work very nicely. The Zener diode (CR_1) shown in Fig. 1 costs between $3.00 and $5.00. A pot set at +3 volts will work, but not as well. Decoupling must be used between the first two stages of the Penfield amplifier, to prevent motorboating, when the power supply of Fig. 1 is used. If a six-volt battery is used, this will not be necessary because of the lower impedance.

Since the author is a staunch defender of the term "high-fidelity" he makes no claims that this tuner is a "hi-fi unit"—but it does sound remarkably good when played through the transistor amplifier or either of his vacuum-tube stereo channels. We are fortunate, here in the Los Angeles area, in having excellent FM-FM stereocasts



R_1—25,000 ohm, 1/3 w. miniature pot
R_2—1500 ohm, ½ w. carbon res.
R_3—12,000 ohm, ½ w. carbon res.
R_4—2200 ohm, ½ w. carbon res.
R_5—470 ohm, ½ w. carbon res.
C_1, C_3, C_7—.05 μfd., 100-500 v. tubular or disc capacitor
C_2, C_6—470 μμfd., 100-500 v. ceramic or silver mica capacitor
C_4—3-12 μμfd. variable capacitor
C_5—5-15 μμfd. variable capacitor
C_8—2 to 10 μfd., 15 v. elec. capacitor
C_9—500 μfd., 15 v. elec. capacitor
C_{10}—5000 μμfd., 100-500 v. disc ceramic capacitor
C_{11}—100 μfd., 3 v. elec. capacitor
RFC_1—30 μhy. r.f. choke
L_1—5 t. #16 tinned copper wire, ⅛" dia., approx. ⅜" long, center-tapped
L_2—1 t. #22 plastic insulated wire, ⅛" dia., inserted in first turn of L_1, at cold end of L_1.
S_1—Miniature d.p.s.t. toggle switch
T_1—Mod. trans. 10,000 ohms to 5000/8000/10,000 ohms, 3 watts (Triad M1-X or equiv., see text)
V_1—3N25 tetrode transistor (Texas Instruments)
V_2—"p-n-p" transistor (2N107, 2N34, CK722, or 2N44, etc.)

Fig. 2. Complete schematic diagram and parts list for the superregen receiver.

available daily for sixty minutes and for a three-hour period every Sunday. This FM tuner gives a good account of itself on these broadcasts. There is no problem of re-radiation from the superregenerative tuner as the stations are far enough apart, frequency-wise, to eliminate this possibility.

Perhaps you won't want to use this unit with your home amplifier. With a little imagination, many other uses will occur to you. It could be added to your car radio by feeding the output of the tuner into the audio system of your car radio. A small jack and a d.p.d.t. switch would take care of that. If you have a positively grounded six-volt ignition system—your negative six volts is ready—although this, too, had better come through the hash filter of your car radio. A negative twelve-volt system would require a voltage-dropping resistor.

Just as it is, the tuner puts out fair headphone volume. One more audio stage should make it usable as an FM pocket receiver with plenty of gain and low battery drain. For T_1 (Fig. 2), one of the many subminiature interstage transformers would work well here as low-frequency response is not a criterion of earphone operation.

Tuning is not as broad as with the ordinary vacuum-tube superregenerative receiver. There are two spots

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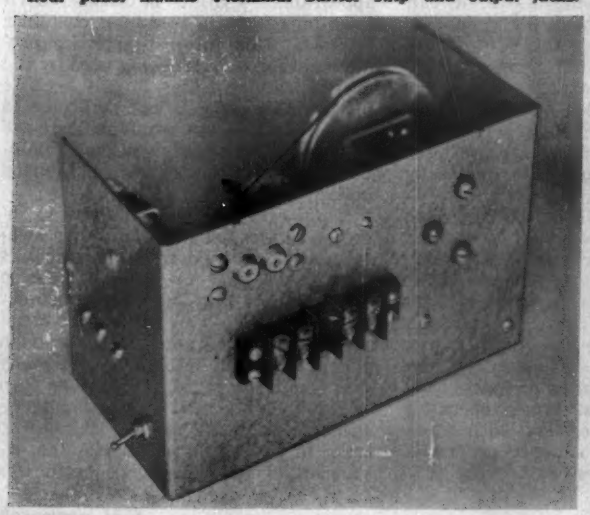
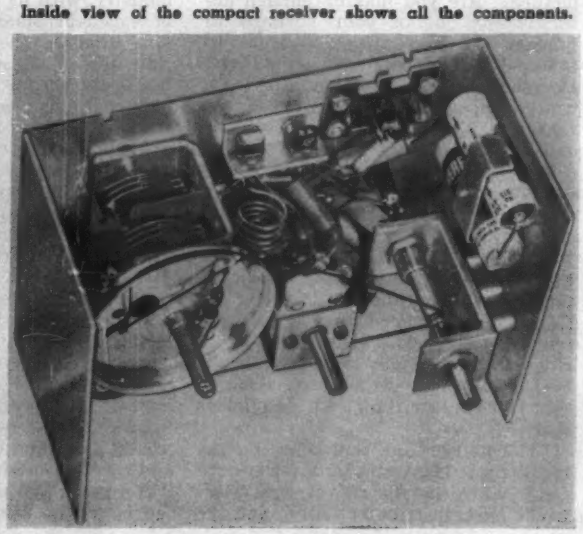
Rear panel mounts 4-terminal barrier strip and output jacks.

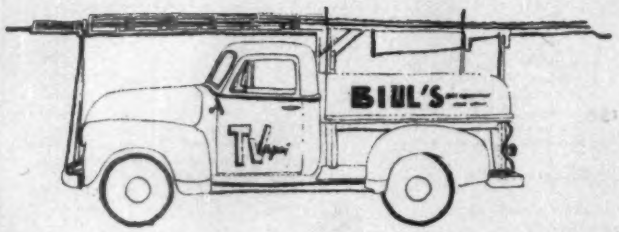


Inside view of the compact receiver shows all the components.



"MUSTS"

FOR BUSINESS GROWTH



By **WILLIAM LEONARD**

Before you can take advantage of new electronic service opportunities, present net profits must be adequate.

AS A SERVICE dealer or technician, you are engaged in the fastest growing industry our economy ever has experienced. You are in an industry that offers you tremendous possibilities for growth. For consumers, for manufacturers and processors, for retailers and for public services, the electronic development laboratories continue to pour out a stream of electronic devices that stagger the imagination with their business potentials.

Irrespective of the fond dreams of manufacturers that virtually service-free electronic devices are in the foreseeable future, the installation and servicing of the new devices, as well as service on current products, will continue to increase the demand for competent service personnel and facilities in the years ahead.

Where do you fit in this opportunity picture? Are you making enough actual profit out of your business to finance the necessary expansion to take advantage of new possibilities? Do your operating statements reveal a well-managed, profitable establishment that would justify a business loan for expansion purposes?

To a certain degree, most service dealers are faced with the same kind of financing problems that their parts distributors are trying to solve for themselves. Here is a synopsis of the average parts distributor's financing problems as outlined by Gordon K. Douglass, manager of financial and operations analysis for *Sylvania Electric Products Inc.* Under the title "Treadmill to Oblivion," in a recent issue of the "NEDA Journal," Mr. Douglass said:

"The market for replacement electronic parts is growing at a faster rate than is healthy for the average electronic parts distributor. All of you are running like the devil just to stay in place. You're trying the best ways you know how to generate enough profit in your business to pay yourself a fair wage and still have enough left over to 'finance' the growth you must have to retain your share of the market.

"Unfortunately, the majority of you are not making quite enough profit to do both of these things. You are on a treadmill, and whether or not you are on a 'treadmill to oblivion' will depend upon the speed with which you learn how to manage your affairs better, and the wisdom with which the industry or the financial community makes available to you the funds for your growth which you cannot generate yourselves."

Since TV servicing has been responsible for the development of the current independent electronic service industry, with its nucleus of thousands of excellent small businesses, it can also serve as the base for expansion into new fields of activity for those dealers whose operations are profitable enough to finance expansion. An important factor in this potential development is, of course, whether the operating profits of TV service businesses are keeping pace with the rising costs of operating.

In a recent speech to the American Society of Refrigerating Engineers, Robert S. Geran, general service manager for the *Kelvinator Division* of the *American Motors Corporation,* told his audience that "It costs $6.02 an hour currently in a typical large U. S. city just to keep a service man on the street." He said this includes basic wages and fringes, truck operating costs, and some overhead, with no allowance for special expenses or profits. "Ten years ago these costs were $3.77 an hour," he said.

While many small service dealers claim their costs of operating are considerably less than six dollars per-hour-per-man, they readily admit they have not increased their service charges during the past five years in proportion to the increases in living costs and in the costs of doing business during the same period. One result of this steady narrowing of the usable income from these businesses is that test equipment, tools, service cars, and trucks are not being replaced at economically wise intervals. This would indicate that adequate depreciation charges are not being taken into account in determining the costs of doing business.

Another vitally important business operating factor that is being neglected is that of repainting, redecorating, and re-arranging service stores and shops at regular intervals. In modern merchandising, the maintenance of a good appearance—a front—is considered vitally important in retaining customer interest. This interest-inspiring promotional force is not being used by the average service dealer, largely because his usable income is not sufficient to pay for it. This, too, would indicate the failure to take business-property maintenance into account when figuring operating costs.

Many excellent opportunities to increase service income from home owners have been made available to dealers during the past few years. One in particular is the growing consumer interest in FM. This resurgence of interest in FM programs, largely through the promotional efforts of the many new, small FM stations that have been licensed, has been an interesting development. Some TV service dealers who were in a position to finance the expansion of their businesses into this

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An Improved Multi-Purpose Probe

A single body eliminates the bother of switching scope probes; may also be adapted for meter use.

By
NATHAN KAYE

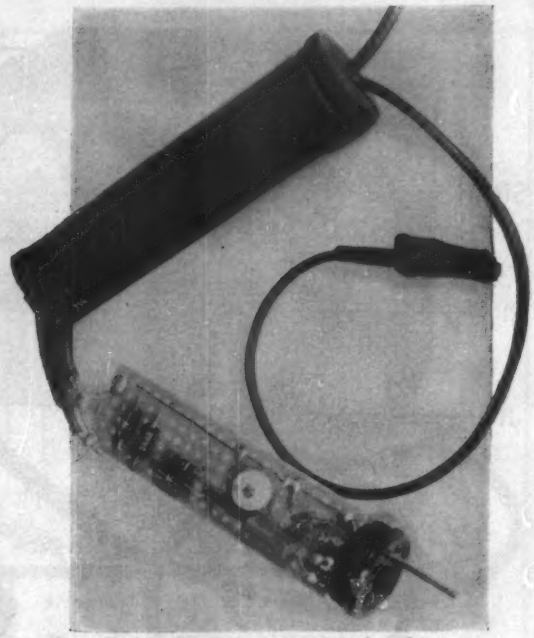

Fig. 1. When the component board is slid into the tubular housing with only the socket showing, this version of the multi-purpose probe will be complete.

LIKE OTHERS of the servicing fraternity, the author had suffered long from that unhappy bench disease, T.T.T. (Terrible Tangle of Test-leads) when "The Multi-purpose Scope Probe" appeared in the January, 1958 issue of RADIO & TV NEWS. A fine idea, but not all of us have the time, talent, and turret lathe to construct that fancy a probe. What to do?

The solution, happily enough, was achieved at little cost and the advantages of the original model were preserved. In addition, some helpful modifications were made and the construction time was reduced to about an hour.

The new, simplified construction incorporates several electrical design improvements over the original. For example, the low-capacity probe function on the original model will pick up hum because of the high order of impedances involved. Shielding on the new model eliminated that problem and the larger internal diameter of the tube used enabled the installation of a trimmer capacitor for exact compensation to the input characteristics of the particular scope on the service bench. As a logical further step, a small hole was drilled in the probe shell to facilitate trimmer adjustment without probe disassembly.

The use of an octal socket afforded several additional input positions. These can be put to good use in such esoteric functions as voltage-doubling demodulation, voltage division, etc., at the option of the user.

The probe assembly is shown clearly in Figs. 1, 2, and 3. The octal socket is held on the end of the perforated Bakelite strip by interweaving the leads of the components going to each of the socket pins through the perforations. The Bakelite component-mounting strip is cut or broken from a larger section of perforated board (*Lafayette* MS305) to a size that will slide snugly

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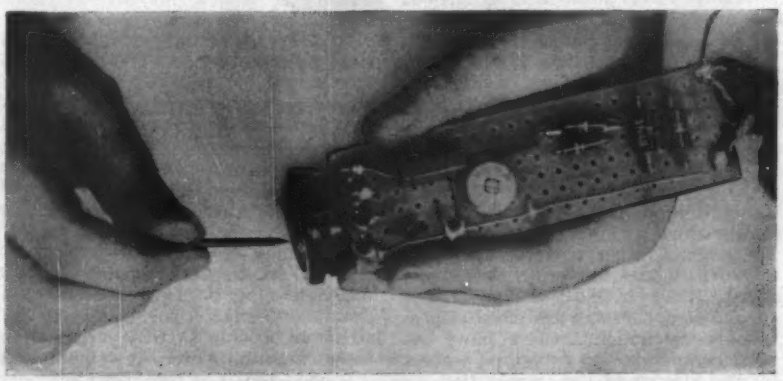
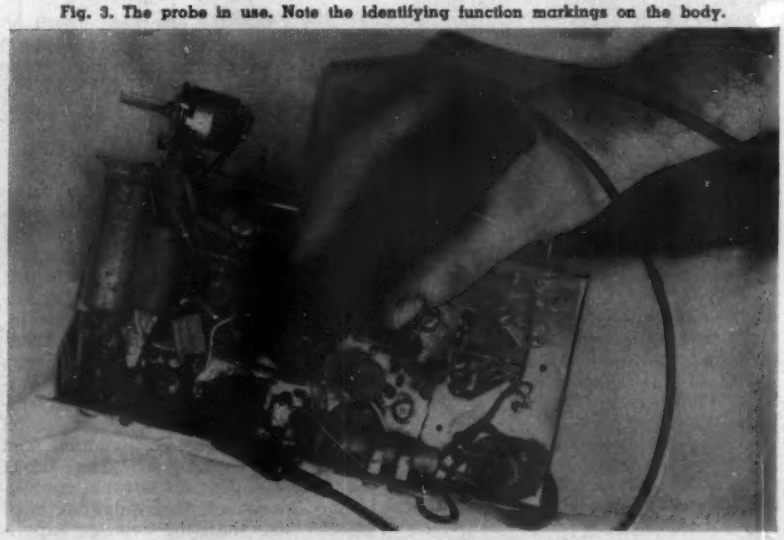


Fig. 2. Inserting the tip in the various socket holes selects probe function.

Fig. 3. The probe in use. Note the identifying function markings on the body.



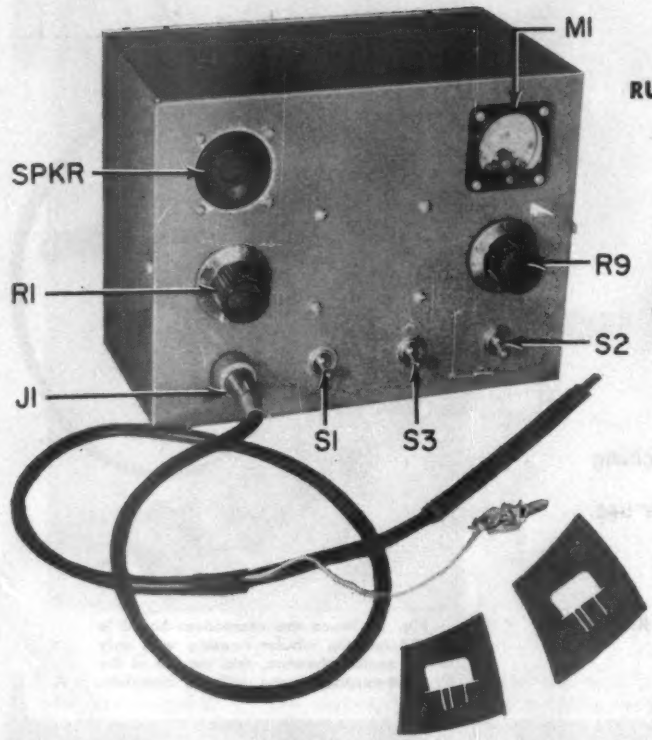


Fig. 1. Front-panel view of the completed instrument.

A Transistorized A.F.-R.F. Signal Tracer

By
RUFUS P. TURNER

A packaged transistor circuit and line-cord-free portability make this unit easy to build and use.

BATTERY operation of a signal tracer is very desirable, since the isolation it provides eliminates the interaction and the hum troubles often encountered with power-line-operated instruments. Also, portable operation is provided and warm-ups are eliminated. However, most of the transistorized signal tracers described in previous construction articles have not been comparable to tube-type tracers by any stretch of the imagination.

To begin with, most of them have had an input impedance of 1000 ohms, which makes serious signal tracing impossible in any but the lowest-impedance circuits. An occasional instrument has been equipped with a step-down input transformer in an attempt to provide higher input impedance, but a transformer at the input of a high-gain amplifier is extremely susceptible to hum pickup. Additionally, most of these earlier instruments provide only headphone operation, and the use of headphones in signal tracing often is a nuisance and sometimes is dangerous. A few instruments which did use loudspeakers had insufficient audio power for good volume. Very few gave any form of visual indication.

The a.f.–r.f. signal tracer described here (Fig. 1) overcomes the shortcomings of earlier models. It has the flexibility of the tube-type signal tracers and is more sensitive than some of these instruments. Following are its important features: (1) input impedance, 1 megohm; (2) visual (meter) indication; (3) aural (loudspeaker) indication with adequate speaker volume; (4) by means of switches, operator may select visual indication, aural indication, or both; (5) no input or interstage transformers; (6) economical operation from flashlight-type batteries (total d.c. drain is 15 ma.). The completed instrument is only slightly larger than a standard multimeter. It weighs about 3 pounds and runs cool.

Circuit Description

Fig. 2 shows the complete circuit of the signal tracer. This arrangement consists of a 4-stage, high-gain audio amplifier followed by a class A power-output amplifier. The power amplifier, employing a single CK751 transistor, delivers approximately 20 milliwatts to the loudspeaker. This gives adequate volume. The 4-stage, low-noise amplifier is a commercial subminiature unit (*Centralab* TA-11) which is only 1.175″ long, 0.665″ wide, and 0.250″ thick. As shown in Figs. 2 and 3, this tiny amplifier has only seven pigtails for connection into the tracer circuit. (All capacitors, resistors, and transistors are self-contained in the hermetically sealed TA-11 unit.) By employing a ready-built commercial amplifier in this critical position, much of the mechanical construction and wiring are eliminated. (The TA-11 amplifier contains 39 internal connections.) Moreover, this amplifier is of smaller size than the average experimenter could achieve with commercial transistors, capacitors, and resistors.

The only external stage required is the power amplifier for driving the loudspeaker. This stage contains a CK751 medium-power transistor. Bias stabilization in the output stage is provided by the base voltage divider (R_6-R_7) and the emitter resistor (R_8). The subminiature 30-μfd. electrolytic capacitor (C_4) adequately bypasses the emitter resistor to prevent degenerative loss.

The meter indicator circuit contains a 0-50 d.c. microammeter (M_1) meter-sensitivity control potentiometer (R_9), two CK705 germanium diodes (CR_1 and CR_2), meter switch (S_3), and coupling capacitor (C_3).

Visual indications of signal strength are obtained when switch S_3 is closed. The output amplifier and loudspeaker are switched into operation for aural indications of signal strength when switch S_3 is closed. Both meter and speaker are placed in operation by closing both S_2 and S_3. The gain-control potentiometer, R_1, is placed at the input of the instrument to prevent overloading of the TA-11 amplifier by high-amplitude signals. The meter-sensitivity control potentiometer, R_9, serves to set the meter to full scale (or to any other scale point) for any selected input-signal voltage.

The instrument is powered by a 6-volt battery consisting of four 1½-volt Size-C flashlight cells connected in series. A tap is taken at the negative terminal of the first cell in the series to provide −1½ volts for the TA-11 amplifier. The CK751 receives the full 6 volts.

The input a.f. signal is applied to a concentric jack, J_1, which accommo-

R_1—1 megohm pot
R_2—10 megohm, ½ w. carbon res.
R_3—240 ohm, ½ w. carbon res.
R_4—25,000 ohm, ½ w. carbon res.
R_5—1000 ohm, ½ w. carbon res.
R_6—5600 ohm, ½ w. carbon res.
R_7—47,000 ohm, ½ w. carbon res.
R_8—130 ohm, ½ w. carbon res.
R_9—1000 ohm wirewound pot
C_1, C_3, C_5—.1 µfd., 200 v. miniature metallized tubular capacitor (Aerovox P82Z)
C_2—30 µfd., 50 v. miniature elec. capacitor (Cornell-Dubilier TAN-63)
1—Miniature 4-stage transistorized amplifier (Centralab TA-11)
J_1—Chassis-type male concentric jack (Amphenol 75-MC1M)
M_1—1½" 0-30 d.c. microammeter (Cal-Rad MO-38 or equiv. Available from California Radio & Electronics Co., 823 N. Highland Ave., Hollywood, Calif.)
S_1—D.p.s.t. toggle switch
S_2, S_3—S.p.s.t. toggle switch
CR_1, CR_2—Germanium diode (Raytheon CK705 or 1N34)
B_1—6-volt battery (four Size-C flashlight cells connected in series and tapped at −1.5 volts, see text)
Spkr.—1½" PM dynamic speaker (Argonne AR-93; with matching output trans., designated as the AR-99)
T_1—Miniature transistor output trans. 2000 ohms to 10 ohms (available with matching speaker as Argonne AR-99)
V_1—"p-n-p" transistor (Raytheon CK751)

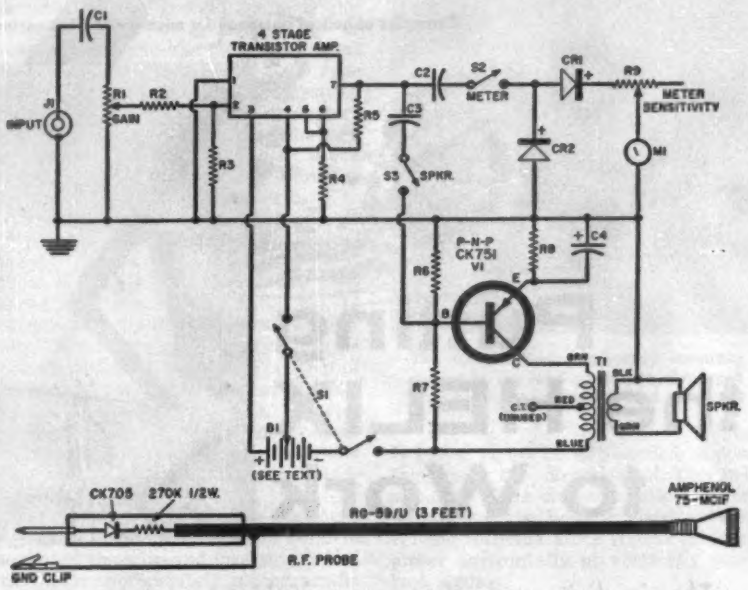


Fig. 2. The signal tracer circuit built around the packaged transistor amplifier. The auxiliary r.f. probe is also shown.

dates the shielded a.f. and r.f. probes. The a.f. probe is a conventional shielded test probe. No capacitor or diode is required in this probe. The r.f. probe, shown in Fig. 2, contains a CK705 germanium diode which demodulates the amplitude-modulated test signal. Connected in series with this diode is a 270,000-ohm resistor for isolating the cable capacitance and tracer-circuit input capacitance.

Construction and Wiring

Many different layouts are possible. As shown in the photographs, the instrument is built in an aluminum chassis box 8" long, 6" high, and 4" deep (*LMB* No. 146). Figs. 1, 3, and 4 show construction details.

Most of the components are mounted on a perforated phenolic board 5¼" long, 3" wide, and 1/16" thick. (See Figs. 3 and 4.) The pigtails of the components are passed through perforations in this board and interconnected underneath to complete the circuit. In this way, a simple assembly is obtained which has much of the compactness of a printed circuit. Twelve solder lugs, secured along three edges of the board, provide connection points for external wiring. The subminiature output transformer (T_1) is held to the board by means of Duco cement. Before applying the cement *to both transformer core and board,* scrape the glaze away from the board in the area to be occupied by the transformer. Coupling capacitor C_5 has been mounted under the board in the author's instrument, hence does not appear in the illustrations. However, this capacitor may easily be mounted on top of the board with the other amplifier components. The CK751 transistor has a mounting lug which holds it to the board with a 6-32 screw and nut.

The circuit board is held to the floor of the instrument case by four 1"-long

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Fig. 3. The circuit board, with most components mounted.

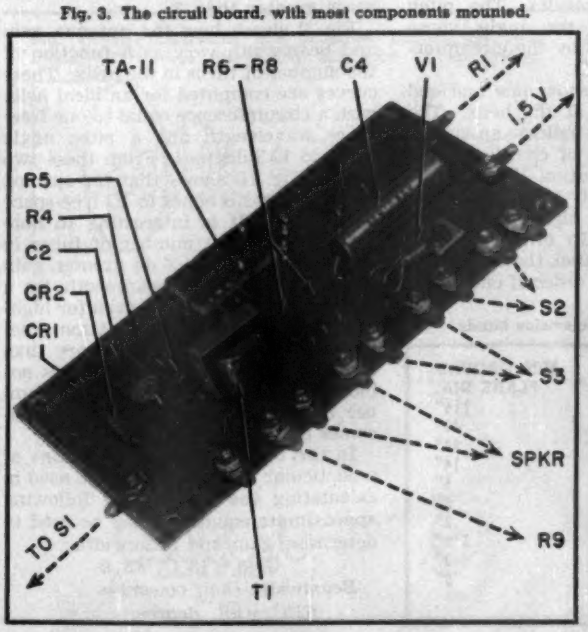
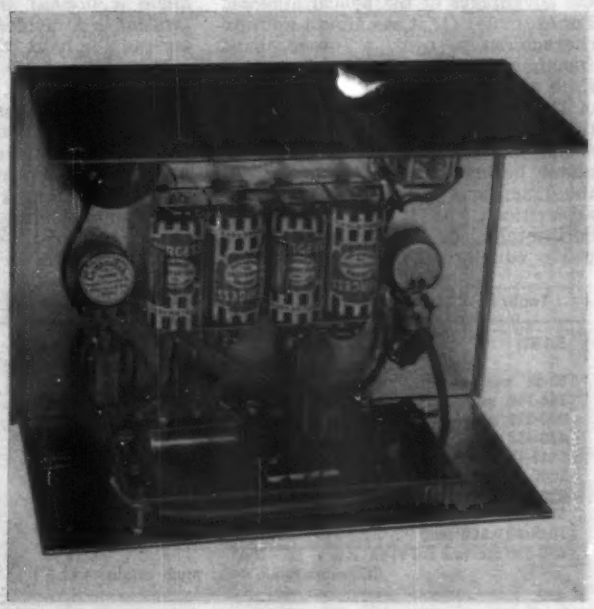


Fig. 4. Inside view of the housing for the signal tracer.



Examples of helical antennas for micro[illegible] frequencies.

Putting the HELIX to Work

By WILLIAM L. BLAIR
K6OXW
Hughes San Diego Laboratories
Solana Beach, California

The simplicity and effectiveness of this proven antenna make it ideal for u.h.f. TV and the higher ham bands.

THE helix is one type of antenna which has not become too popular with amateurs thus far. This is so because, for frequencies of 144 mc. and below, its dimensions become large and the antenna is usually unwieldy to handle. *(Editor's Note: For information on a 108-mc. helix, see the article "Listening to the Satellites" on page 44 of this issue.)* However, as more and more amateurs explore the higher frequencies, the helix may well become "old reliable" in a relatively short period of time.

In planning for operations in the higher amateur bands, enthusiasm mounts quickly when one begins to list the advantages of the helical antenna. For example: (1) it has almost uniform characteristics over a broad band (maximum to minimum frequency ratio approaching 1.8 to 1); (2) gains of 15 db over this band are readily obtainable; (3) the radiation pattern is a single major lobe with typical half-power beamwidth of 30 degrees; (4) the dimensions of the helix are not at all critical; (5) it intercepts either horizontally or vertically polarized waves equally well; and (6) the antenna is backed by a ground plane and is ideally fed with coaxial c[illegible]

An excellent theoretical d[illegible]sion on helical antennas is included [illegible]e book "Antennas" by John D. Kra[illegible] However, only the general design equations are necessary for the construction of practical antennas.

Fig. 1A indicates the important dimensions of a helix and its ground plane. D is the diameter of the helix, L the length of one turn, S the distance between turns, n the number of turns, and d the diameter of the ground plane. If one imagines that one turn has been unwrapped and laid out flat, the triangle of Fig. 1B results. The pitch angle α (*alpha*) is the angle whose tangent is S divided by the circumference of the helix, πD.

Figs. 1C and 1D show side and end views, respectively, of the helix. The plus and minus signs indicate an instantaneous distribution of charge for the axial mode of operation. This is the mode most commonly used and is one which results in a highly directional radiation pattern. In order that the charge be so distributed, the circumference must be on the order of one wavelength at the desired operating fre[illegible]ency. As examples of the latitude permissible in the dimensions, this axial mode of operation is readily obtained with circumferences between ¾ and 4/3 of a wavelength, pitch angles from 12 to 15 degrees, and any number of turns greater than 3.

Fig. 2 shows how the antenna gain and beamwidth vary as a function of the number of turns in the helix. These curves are computed for an ideal helix with a circumference equal to one free-space wavelength and a pitch angle equal to 12.5 degrees. From these two values, Fig. 1B shows that the spacing between turns is equal to .22 free-space wavelength. It is interesting to note that doubling the number of turns in the helix results in 3 db greater gain and a reduction in beamwidth by a factor of .707. Generally even for high-frequency antennas, it is not too practical to build helices with more than about 15 turns since the gain does not increase very rapidly above this number and support of the structure becomes more of a problem.

In the event that the dimensions of a particular helix are not those used in calculating the curves, the following approximate equations may be used to determine gain and beamwidth:

$$Gain = 15\ C_\lambda^2 nS_\lambda k$$

$$Beamwidth\ (half\ power) = \frac{52}{C_\lambda \sqrt{nS_\lambda}}\ degrees.$$

Table 1. Dimensions of helical antennas for various amateur and television bands.

BAND	HELIX DIA.	TURNS SPACING	MIN. GROUND PLANE DIA.
50-54 mc.	72"	50"	114"
144-148 mc.	26"	18"	41"
220-225 mc.	17"	11⅞"	27"
420-450 mc.	8½"	6"	14"
1215-1300 mc.	3"	2"	5"
2300-2450 mc.	1⅝"	1⅛"	3"
3300-3500 mc.	1⅛"	¾"	2"
5850-5925 mc.	⅝"	7/16"	1⅛"
10,000-10,500 mc.	⅜"	¼"	1"
470-890 mc. (u.h.f. TV)	5¼"	3⅝"	9"

(Circumference = λ; pitch angle = 12.5°)

In these equations, C_λ and S_λ are the circumference and turns spacing, respectively, in wavelengths. They apply only for the axial mode of operation where C_λ is between ¾ and 1½, α is between 12 and 15 degrees, and n is greater than 3. Gain in db may be determined by taking ten times the logarithm of the number obtained from the first equation. In this equation k is the radiation efficiency factor. For the ideal loss-less antenna assumed in the curves, $k = 1$, but where losses are present, k is always somewhat less than 1. In approximating the gain of a particular antenna, the value obtained from the curve should be reduced by 2 to 3 db in order to account for this factor.

Table 1 gives the dimensions of helical antennas suitable for several of the higher frequency amateur bands, as well as for the u.h.f. television band. In television, this type of antenna is especially effective because of its high gain over such a broad bandwidth. Some amateurs have built helical antennas for the lower ham bands, but the size of the structures becomes larger as the frequency goes down and rotation becomes a problem. However, for propagation in one fixed direction this type of antenna holds out real possibilities. In this case the ground plane would be fabricated of large mesh screening in order to reduce wind resistance.

The three antennas shown in the photographs were constructed for operation in the microwave bands. From the largest to the smallest, the center frequencies are: 1250 mc., 3000 mc., and 10,000 mc. respectively. The two smaller ones were wound on wooden dowels while the largest one had a hollow 3" cardboard tube for the helix support. In the latter case, wooden plugs cut from ½" plywood were inserted in the ends of the tube for rigidity.

In each instance the ground plane was made by fastening sheet aluminum to ½" plywood with wood screws. The diameter of the ground plane is not critical as long as it is equal to or greater than one-half wavelength at the operating frequency. A type UG-58/U coax connector was mounted behind the ground plane by means of machine screws which passed through the plywood and aluminum sheet. Lock washers should be used under both the heads of the screws and the nuts in order to insure good electrical contact between the coax shield and the ground plane.

The largest helix was wound with No. 14 solid copper wire while No. 16 bus wire was used for the two smaller units. A uniform spacing of the turns is easily obtained by cutting a strip of cardboard as wide as the desired spacing and then winding it with the wire between turns. If the strip of cardboard is not long enough for the whole helix, it may be advanced as the winding progresses.

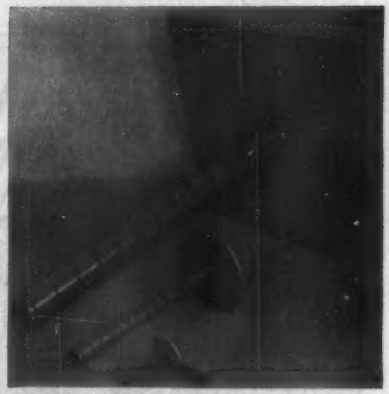
The end of the winding is anchored in place by fashioning a small bend in the end of the wire and inserting it in a small hole appropriately placed at the end of the tube or dowel. For protection from the weather several coats of *Krylon* spray-on plastic and a final coat of paint were applied.

An empirical equation for the antenna impedance, in ohms, is:

$$R = 140 \times \textit{circumference in wavelengths}$$

For the preceding examples of helices with circumferences equal to one wavelength, a 93-ohm coaxial transmission line could be used for a good match. However, for the antennas pictured, a 75-ohm line was used with excellent results.

Because of the configuration of the helical antenna, the radiation is, in general, elliptically polarized or, for certain dimensions, circularly polarized. The direction of rotation of the polarization



The three helical microwave antennas shown in the lead photo are displayed here before being mounted on the mast.

is either right- or left-handed, depending upon the direction of the helix winding. This characteristic is fortunate when the helix is used as a receiving antenna since it will intercept either horizontally or vertically polarized signals.

For communication between two locations both using helical antennas, it is necessary that both antennas be wound in the same direction. An electromagnetic wave possessing one direction of polarization rotation will have a minimum interaction with an antenna designed for the opposite direction of polarization rotation. It is recommended that a right-hand sense convention be used for uniformity.

In general, it may be said that the helical antenna is one of the simplest and most effective beam-type antennas it is possible to make. So, when the day finally arrives when you get around to firing up those klystrons that came in your big surplus "buy"—think of the "old reliable" helix and put it to work! -30-

Fig. 1. (A) Dimensions and radiation pattern. (B) Pitch angle. (C) Charge distribution, side and (D) end views.

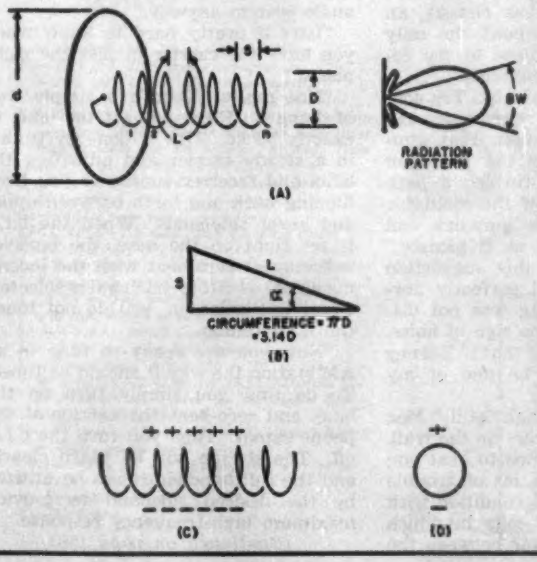
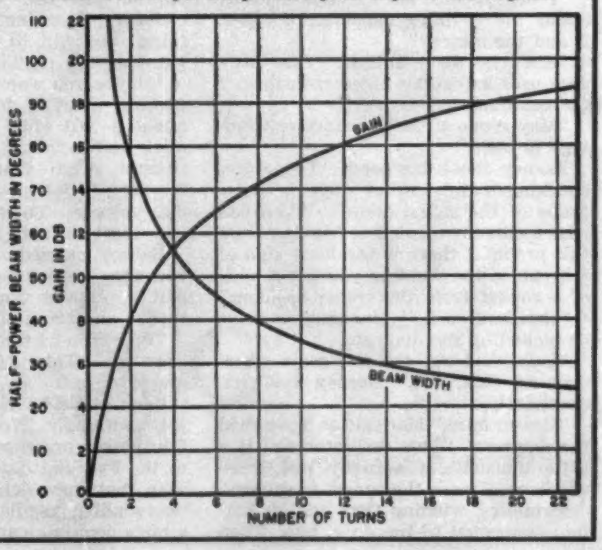


Fig. 2. Antenna gain and beamwidth shown as a function of the number of turns, for a helix having a circumference equal to one wavelength along with a pitch angle of 12.5 degrees.



By JOHN T. FRYE

A LITTLE DOG AND SSB TUNING

BARNEY was muttering to himself and Mac, his employer, knew from experience that this meant the youth was having trouble with his work. Finally the older man laid down his solder gun and strolled over to where the youth was poking aimlessly around the wiring of a little a.c.-d.c. receiver with the noise probe of the signal tracer.

"Want to tell Daddy?" Mac asked soothingly.

"I want to tell somebody!" Barney exploded. "This cotton-picking set about has me ready to blow my stack. For a while it plays fine; then it starts getting noisy; next it goes dead on all but local stations; finally it will play OK again for a half hour or so. And it's *not* tubes, for I've changed 'em all," he concluded.

Mac cocked a practiced ear at the set that was now in the noisy part of its cycle.

"Bad i.f. transformer?" he hazarded.

"Nope," Barney denied with conviction. "I tacked in new ones to make sure."

"I see it has an r.f. stage. How about the coupling capacitor between it and the mixer?"

"Ain't no such animal. This little gem uses a regular tuned transformer for coupling."

"Maybe one of the transformer windings is bad?"

Barney shook his head. "I was just checking both windings with the noise probe of the signal tracer. When you pass a current through a winding from this probe, if there is the least sign of a break in the winding you get a heck of a racket from the tracer speaker."

"Oscillator coil?" Mac suggested as he picked up the diagram.

"I checked out the two main windings on that, too," Barney said triumphantly.

"Hm-m-m-m," Mac said as he studied the diagram. "This oscillator coil is a little unusual: it actually has three windings. One is the tuned, frequency-determining winding that has its bottom connected to the a.v.c. bus. Then there is this feedback winding between the cathode of the 12BE6 mixer and ground. Finally there is this little gimmick winding that has one end going through a 1000-ohm resistor to the oscillator grid. The other end is free. Apparently they just use it for capacity coupling to the tuned circuit. Have you checked for leakage *between* windings?"

Barney shook his head in a crestfallen manner and picked up the noise probe. When its leads were connected between the gimmick winding and the tuned circuit winding, a scratching crackling sound came from the signal tracer speaker.

"Guess that's the trouble," Mac said as he continued to study the diagram. "When that gimmick winding intermittently short-circuits to the tuned winding, it places the oscillator grid voltage on the a.v.c. bus and biases the tubes so high only the local stations can get through."

"I'll buy that, but what do we do about it? This set's an orphan, and we can't get an exact replacement; but on that crowded, shallow chassis, an exact replacement is about the only thing that will fit. I hate to try revamping the oscillator circuit."

"Maybe you won't have to. Try connecting a small mica capacitor, say about a .001 μfd., between that gimmick coil terminal and the 1000-ohm resistor. That should furnish a path for the r.f. but block off the oscillator d.c. voltage. Then the gimmick coil can short or not, just as it pleases."

Barney carried out this suggestion and the receiver acted perfectly normal. Oscillator tracking was not disturbed and there was no sign of noise.

"Why didn't I think of that?" Barney growled. "This must be one of my stupid days."

"You would have thought of it," Mac said soothingly. "You were on the trail. I just used my experience to beat you to it. I've had quite a bit of trouble with that same general condition with two-winding oscillator coils in which a mica coupling capacitor between the tuned winding and the oscillator grid becomes leaky and produces the same symptoms. But let's talk about something else. How are you making out with that new selectable-sideband ham receiver of yours?"

"Fine, fine," Barney said; "and you know something? I'm finding out that quite a few hams who own this general type of receiver do not know how to tune them correctly."

"Yeah," Mac said skeptically.

"I know it sounds wacky, but it's true. It's on tuning AM stations they fall down. On SSB, either you tune the thing right or you get nothing but gobbledygook; but you can get some reception of AM stations even though you mistune the set."

"Spell it out for me," Mac suggested.

"Well, the main point is that you're supposed to receive just one sideband of an AM station at a time with these receivers. That's all you need since the two sidebands ordinarily carry the same information. Now in order to receive just one sideband, the carrier has to be placed pretty exactly on the selectivity curve of the 50 kc. i.f. passband. You don't place the carrier in the center of that passband the way you do with an ordinary receiver; you put it on the low-frequency skirt."

"Why?"

"Well, suppose this is the 50 kc. selectivity curve," Barney said as he sketched a flat-topped hairpin on a piece of paper. "Now suppose we have the passband adjusted for 3 kc. bandwidth. If we put the carrier in the center, that leaves only 1.5 kc. on either side, which means our high-frequency response will be restricted to 1500 cycles. But if the carrier is put over here about half-way down on the low-frequency skirt of the curve, the sideband can use the full 3 kc. bandwidth, giving us frequency response up to 3000 cycles. There will be some attenuation of the frequencies immediately adjacent to the carrier, but these are very low frequencies that would never be passed by the receiver's audio system anyway."

"Isn't it pretty hard to know when you have the carrier in just the right place?"

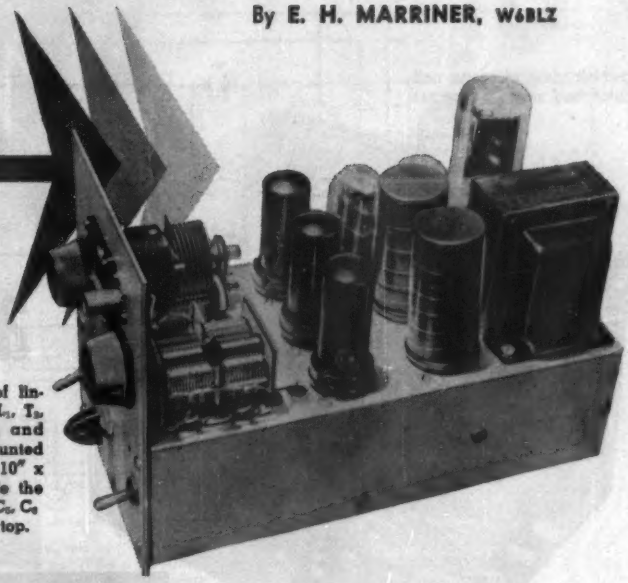
"Not really. There's a simple way of doing it. First, you set the b.f.o. to exactly 50 kc. This is done by tuning in a steady carrier and adjusting the b.f.o. and receiver tuning as you keep flipping back and forth between upper and lower sidebands. When the b.f.o. is set right on the nose, the receiver will stay at zero-beat with the incoming signal as either sideband is selected. From this point on, you do not touch the b.f.o tuning.

"Now you are ready to tune in an AM station the way it should be tuned. To do this, you simply turn on the b.f.o. and zero-beat the carrier of the phone signal. Then you turn the b.f.o. off. The station will be heard clearly and the full bandwidth can be utilized by the desired sideband to provide maximum high-frequency response. If

(*Continued on page* 158)

Linear Amplifier for SSB Exciters

By E. H. MARRINER, W6BLZ



Over-all view of linear amplifier. L_2, T_2, CH_1, R_1, RFC_1, and RFC_2 are mounted below the 5" x 10" x 3" chassis, while the tubes, T_1, C_2, C_4, C_5, C_6 are mounted on top.

This combination tester and low-power ham rig is built with standard receiving-type tubes and parts.

MANY SSB exciters do not have sufficient power output to produce a pattern on the scope screen when fed directly to the plates during alignment procedures. This is often a problem if the exciter has to be taken to the shop for servicing and the regular amplifier is too large to move.

The following is a description of a small, economical grounded-grid linear amplifier, constructed of receiving-type components, which provides sufficient power output to enlarge the scope pattern to a point where it is of suitable size for use in troubleshooting. The amplifier may also be used as a second transmitter of 50 watts peak input power for vacation or field-day operations.

Because SSB utilizes pulse power, small current transformers may be used in a bridge circuit to obtain a high-voltage plate supply.

The receiving-type filter capacitor is made up of two electrolytics, rated at 450 w.v., connected in series to withstand the high voltage. The 40/40/40 μfd. sections of each unit are in parallel while the two cans are series-connected. C_3 should be insulated with electrical tape as the case will be above ground.

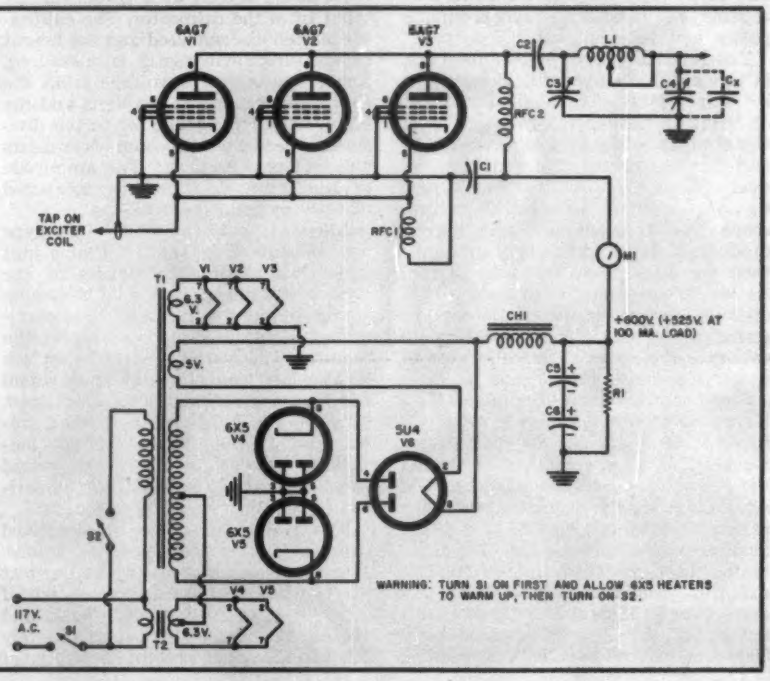
To operate the power supply, S_1 must be turned on first to allow the 6X5 tubes to heat up before S_2 is turned on. To feed a signal into the scope, the grounded-grid 6AG7 tubes may be driven from a 5-watt SSB exciter whose output is tapped up from the grounded end of the output tank coil. This provides a ground return for the 6AG7's. The chassis must be bonded together.

The output of the pi-network should be terminated in a lamp bulb or a 50-ohm resistor. Five turns of hook-up wire should be wound around the plate end of the tank coil and run directly to the vertical plates of the scope.

If the amplifier is to be used on the air, a 50-ohm coax antenna feedline may be connected directly to the output and the capacitor resonated for maximum output. For 80-meter operation it may be necessary to parallel a 200 μμfd. (or more) silver mica capacitor across C_4, the output pi-network capacitor, to match the 50-ohm coax.

The author has enjoyed considerable success using this amplifier as a portable rig, making 40-meter contacts up and down the California coast, feeding a 40-meter dipole. —30—

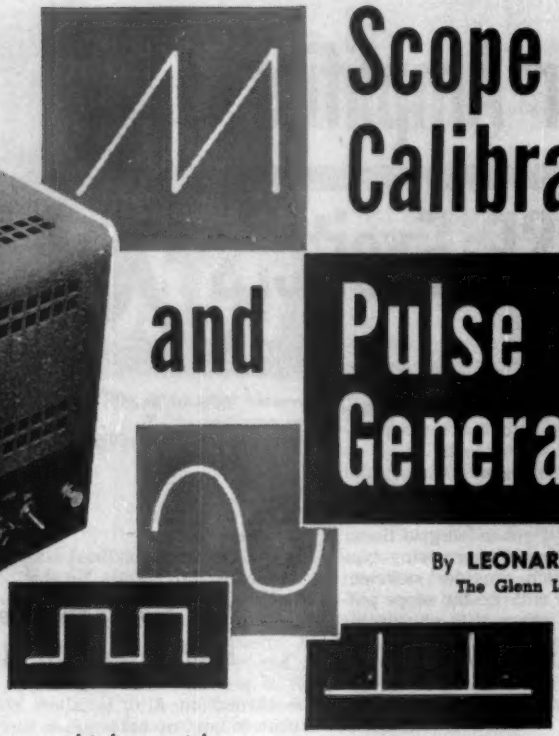
Complete schematic of linear amplifier which can double as an SSB exciter tester and low-power ham rig for field day or portable use on the 40-meter band.



R_1—100,000 ohm, 20 w. wirewound res.
C_1—.005 μfd. disc ceramic capacitor
C_2—.002 μfd., 600 v. silver mica capacitor
C_3—250 μμfd. receiving-type tuning capacitor
C_4—365/365 μμfd. ganged receiving-type tuning capacitor. (Note: Pad if necessary with silver mica trimmer for 80 meters. Approx. 1200 μμfd. total capacity required)
C_5, C_6—40/40/40 μfd., 450 v. elec. capacitor (see text)
C_x—Padder (see text)
RFC_1, RFC_2—2.5 mhy., 125 ma. filter choke
CH_1—10.5 hy., 110 ma. receiving-type choke
L_2—Tank coil ("Air Dux" 820D10, Illumitronic Engineering, Sunnyvale, Calif. Use full coil for 80 m. Tap and short out from ant. end 29 t. of closewound section for 40 m.)
S_1, S_2—S.p.s.t. switch (see text)
M_1—0-200 ma. miniature meter
T_1—Power trans. 350-0-350 v. @ 50 ma.; 5 v. @ 2 amps; 6.3 v. @ 1.6 amps. (Stancor PM- or PC-8409 or equiv. can be used. Author used a Peerless R5069A)
T_2—Fil. trans. 6.3 v. @ 2 amps (Stancor P6466 or equiv. can be used)
Chassis—5" x 10" x 3" chassis, 5¼" x 7" panel
V_1, V_2, V_3—6AG7 tube
V_4, V_5—6X5 tube
V_6—5U4 tube

Scope Calibrator and Pulse Generator

Over-all view of scope calibrator and pulse generator.



By **LEONARD CHIOMA**
The Glenn L. Martin Co.

Construction of a versatile accessory which provides square waves and pulses for many testing purposes.

THE complexity of today's electronic devices often taxes the ingenuity of the engineer who must develop appropriate equipment for testing, servicing, and altering such gear. Even television circuitry requires pulse measurements, a procedure heretofore required only in radar applications. The scope used for television must be capable of measuring synchronizing pulses and video signals.

The relative gain of video amplifiers, in terms of voltage, can be determined by simply measuring a given amount of vertical deflection produced by a signal input to the grid of an amplifier and then comparing this with the vertical deflection produced at the output, *e.g.*, if the input deflects the oscilloscope five divisions and the output produces a deflection of fifty divisions, then we know that the gain is ten. As we do not know what each single division on the screen represents in terms of voltage, it is necessary to calibrate the scope. The calibrator to be described meets this need.

Some commercial scopes have an internal a.c. voltage, ranging from 1.5 to 6.3 volts, provided for calibrating purposes. A simple conversion reveals the peak-to-peak voltage reading. The a.c. voltage that is measured or known is simply multiplied by 2.83 to give the peak-to-peak reading. Fig. 2A illustrates this principle. The simplest calibrator that can be built externally consists of a filament transformer with an output of 6.3 volts shunted by a 5000-ohm potentiometer. The reading is taken on a rectifier-type a.c. meter. See Fig. 2B.

This method will provide a maximum of 17.83 volts peak-to-peak. This output is used as follows: The gain (vertical) control of the oscilloscope is set so that the pattern occupies a definite number of squares on the cross-hatch screen at a given voltage input from the calibrator. The calibrator is then disconnected and the height of the unknown signal is measured. For example, if the voltage from the calibrator was set at ten volts and the amplitude of the scope set to ten divisions, then each division represents one volt peak-to-peak. The amplitude of the unknown signal is measured directly by counting divisions.

Although calibrators of this type are convenient, it was felt that a unit which would produce signals of the type encountered in actual servicing would be more convenient, thus eliminating meter readings and conversion factors. The various waveshapes are provided so that the unknown signal can be compared with a similar signal. This is advantageous in that all frequencies or waveshapes are not amplified equally in the lower priced oscilloscopes and thus a true comparison of readings would be inaccurate.

The instrument to be described overcomes all of these basic objections. It provides square waves, one fixed at 60 cps with a calibrated step output of 1, 10, and 100 volts peak-to-peak, and the other variable from approximately 180 to 1500 cps at an output voltage of from 0 to 120 volts peak-to-peak; a pulse with positive polarity, derived from the square-wave generator, variable from 0 to 50 volts peak-to-peak; a variable saw-tooth frequency, 12 volts peak-to-peak; and a fixed sine-wave voltage of 6.3 volts, or 17.83 volts peak-to-peak.

The complete schematic of the instrument is given in Fig. 1. V_1 is the variable square-wave generator. A 6SN7GT tube is used in the familiar free-running multivibrator circuit. This basic multivibrator is a simple two-stage *RC*-coupled amplifier with the output of the second stage coupled through a capacitor to the grid of the first tube. Since multivibrator theory has been thoroughly covered in the literature, it will not be discussed here. The output from the multivibrator is coupled to a 6C4 (V_2) tube used as an overdriven amplifier in which grid- and plate-circuit clipping occurs. The grid-cathode path of the tube and the grid series resistor form a diode clipper circuit which removes the positive peaks and leaves the negative peaks unaltered. The elimination of the positive half of the grid-voltage wave input from the multivibrator, because of grid current, is called grid-circuit clipping. The flattening of the top of the waveform is the result of the grid voltage falling below the cut-off value and is known as plate-current cut-off clipping. The combination of grid-circuit clipping and plate-current cut-off clipping results in a conversion of the multivibrator output into a good square-wave output. The square-wave output of the 6C4 is coupled to a 6SN7GT used as a dual cathode-follower. The two outputs are taken

from across the 5000-ohm linear-taper pots, R_{13} and R_{14}, which should have calibrated dials for direct readings.

The square-wave input of one section of the cathode-follower (V_3) is differentiated by R_{13} and C_4. As only a positive-going pulse is required, a pair of 1N34 crystal diodes is used to clip the negative-going peaks of the differentiated wave. CR_1 is a series diode used to limit negative signals, as shown in Fig. 3.

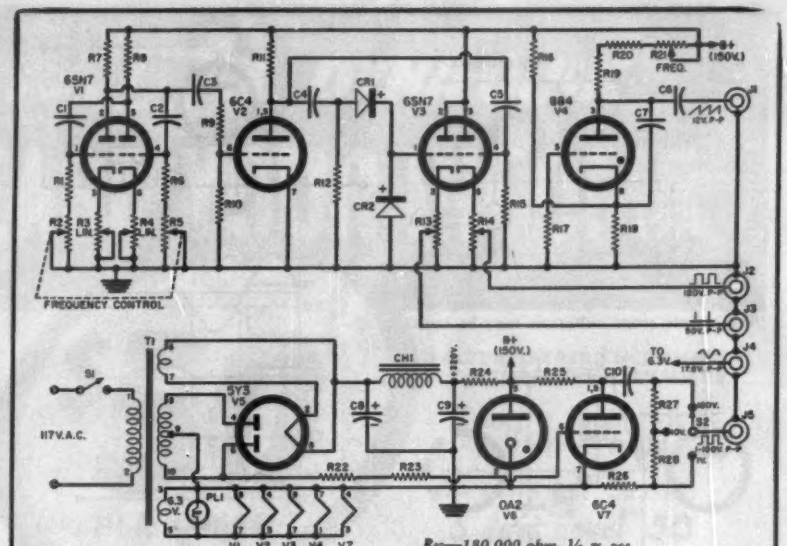
The 1N34 crystals are used in a series- and parallel-limiting diode circuit. The characteristics of a diode are such that it conducts only when the anode is positive with respect to the cathode or when the cathode is negative with respect to the anode. The series diode is used to limit the negative swing of the input voltage. The diode is closed (conducting) during the positive swing of the input voltage and open (cut-off) during the negative swing.

The second crystal diode, CR_2, is the parallel diode limiter connected so as to limit the negative swing. The anode of the diode is held at ground potential so that the diode does not conduct during the positive half cycle, thus the output voltage equals the input voltage. During the negative half cycle of the input voltage, the cathode is negative with respect to the anode and the diode conducts. The output voltage is limited to the very low voltage drop across the crystal. The cathode-follower output is variable from 0 to 50 volts. The 60-cycle square-wave voltage is developed in another 6C4 (V_7), utilizing a combination of grid limiting and cut-off limiting. (For an explanation of this technique, refer to "Principles of Radar" published by *McGraw-Hill Book Company*, New York.)

In the circuit of Fig. 5 the tube is operated in a highly overloaded condition. Although the in-circuit operating voltage is high, there have been no tube failures with this equipment even after many hours of operation. Generally, a test unit of this type is operated for relatively short periods of time and under such conditions will provide trouble-free performance.

The amplitude of the input voltage is sufficiently high to hold the grid beyond cut-off for the greater part of the negative swing. This type of circuit requires large voltage inputs which, in this unit, are derived from the secondary winding of the power transformer.

As the grid tends to go positive relative to the cathode, grid current is drawn. The grid current causes a voltage drop across the series grid resistor from *b* to *a*. The magnitude of the grid current drawn is sufficient to prevent the grid from ever going more than slightly positive. During the negative half cycle, no grid current flows through the grid resistor from *b* to *a* and therefore the voltage wave at *b* has the same shape as that at *a* during this half cycle. As the grid becomes more negative, the plate current drops and plate voltage rises until



R_1—4.7 megohm, ½ w. res.
R_2, R_3—100,000 ohm pot ("Freq. Control")
R_3, R_4—25,000 ohm pot (preset "Linearity")
R_6—8200 ohm, ½ w. res.
R_7, R_8, R_{21}, R_{22}—5600 ohm, 2 w. res.
R_9, R_{23}—100,000 ohm, ½ w. res.
R_{10}—2.2 megohm, ½ w. res.
R_{11}—22,000 ohm, 1 w. res.
R_{12}—56,000 ohm, ½ w. res.
R_{13}, R_{14}—5000 ohm linear taper pot (Allen-Bradley "Type J" "Pulse Gain" & "Sq. Wave Gain")
R_{15}—3.9 megohm, ½ w. res.
R_{16}—180,000 ohm, 1 w. res.
R_{17}—22,000 ohm, ½ w. res.
R_{18}—2200 ohm, ½ w. res.
R_{19}—360 ohm, 1 w. res.
R_{20}—470,000 ohm, 1 w. res.
R_{24}—3 megohm pot ("Saw-tooth Freq.")
R_{25}—5000 ohm, 10 w. wirewound res.
R_{26}—2000 ohm, ½ w. res.
R_{27}—180,000 ohm, ½ w. res.
R_{28}—18,000 ohm, ½ w. res.
C_1, C_2, C_3—.02 μfd., 400 v. capacitor
C_4—100 μμfd., 400 v. capacitor
C_5, C_7—.04 μfd., 400 v. capacitor
C_6, C_{10}—.1 μfd., 400 v. capacitor
C_8—16 μfd., 450 v. elec. capacitor
C_9—40 μfd., 450 v. elec. capacitor
S_1—S.p.s.t. switch
S_2—S.p. 3-pos. rotary switch
PL_1—6.3 volt pilot light
CR_1, CR_2—1N34 diode
CH_1—16 hy., 50 ma. filter choke (Stancor C-1003 or equiv.)
J_1, J_2, J_3, J_4, J_5—Coax. pin jack or both
T_1—Power trans. 300-0-300 v. @ 60 ma.; 5.0 v. @ 2 amps; 6.3 v. @ 3 amps. (Chicago PCC-60 or equiv.)
V_1, V_2—6SN7GT tube
V_3, V_7—6C4 tube
V_4—884 tube
V_5—5Y3 or 5R4GT tube V_6—0A2 tube

Fig. 1. Complete circuit diagram and parts listing of the accessory test unit.

This top view of the scope calibrator, with its cover removed, clearly shows the placement of the tubes that are used along with filters and power transformer.

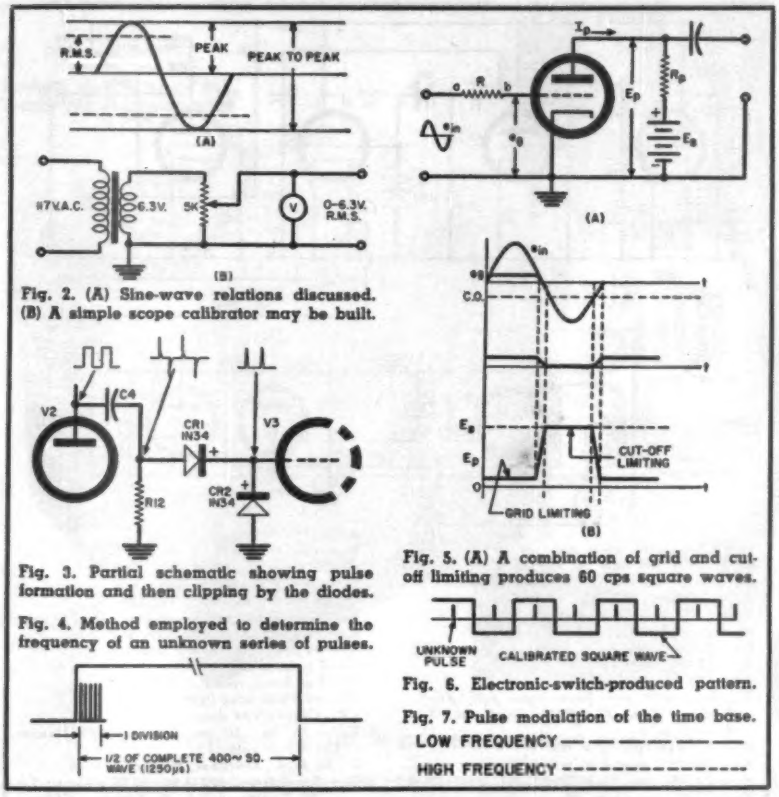


Fig. 2. (A) Sine-wave relations discussed. (B) A simple scope calibrator may be built.

Fig. 3. Partial schematic showing pulse formation and then clipping by the diodes.

Fig. 4. Method employed to determine the frequency of an unknown series of pulses.

Fig. 5. (A) A combination of grid and cut-off limiting produces 60 cps square waves.

Fig. 6. Electronic-switch-produced pattern.

Fig. 7. Pulse modulation of the time base.
LOW FREQUENCY
HIGH FREQUENCY

the grid voltage reaches cut-off. Plate voltage remains at the supply voltage E_B during the time the grid is below cut-off. This results in a square wave at the plate.

The saw-tooth generator is an 884 thyratron, connected in a circuit similar to the scope's horizontal time-base generator. The operation is as follows: R_{10} and R_{11} (Fig. 1) form a voltage divider across the "B+" supply and biases the cathode of the thyratron with a steady voltage. When "B+" is applied, the capacitor in parallel with the 884 tube's plate begins to charge toward "B+." When the plate voltage rises to a point where the bias voltage is overcome, the tube fires, lowering the plate voltage to a small voltage drop across the tube. This collapse of plate voltage restores bias control on the thyratron and the cycle repeats, producing a continuous saw-tooth voltage output.

The unit was calibrated using an *RCA* "VoltOhmyst WV-75A." The measurement was made with the gain controls set at maximum and then noting the peak-to-peak readings on the proper scale. Another method is to use the circuit shown in Fig. 2B and follow the technique described.

The two cathode-follower pots used in the construction are of the linear type (*Allen-Bradley* "Type J"). A dial scale of the type used as an amplifier gain control indicator can be employed to give direct readings. Suitable units with dial markings of 0-100 are available. As the potentiometers are reasonably linear, the voltage outputs can be read directly, for example, on a pulse output of 50 volts with the dial scale set to 100, one-half will be 25 volts, etc. For maximum accuracy care should be taken in initially setting the dial pointers.

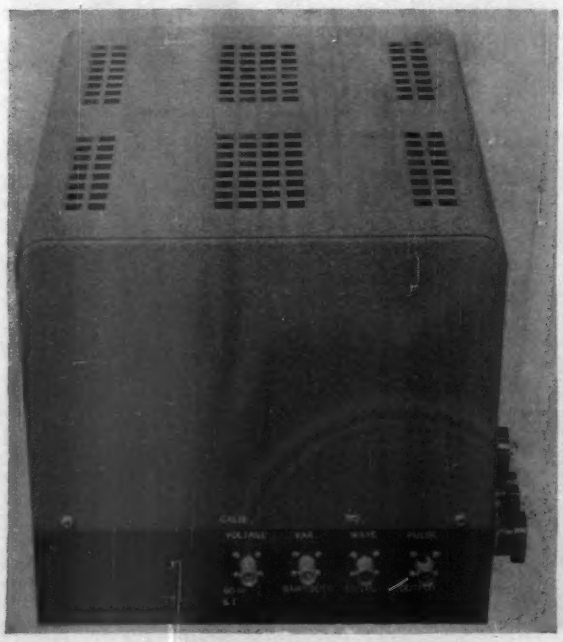
Applications

In applying the calibrator, the variable outputs are substituted for the signal under test and varied for equal peak-to-peak deflection. The calibrator voltage is then read directly on the calibrated dials. The use of an electronic switch, in which the calibrating and unknown voltages are shown on the scope screen simultaneously, is a good method of comparison since it is unnecessary to switch the two signals. An example of this technique is shown in Fig. 6. Here the unknown is the pulse and the variable square-wave output is used. As shown, the pulse is of lesser amplitude and the square wave must be reduced to match.

If the variable square-wave generator is set at 400 cycles it represents a total cycle time of 2500 microseconds. By using the positive alternation as a fixed time-base and spreading it across the scope screen so that it covers exactly 25 spaces, each space will represent 50 microseconds. With this technique, the unknown pulse frequency can be determined, as indicated in Fig. 4. For example, if five pulses appear per square then we know the pulse spacing is 10 microseconds with a repetition frequency of 100 kc.

Further uses of the calibrator include measurement of the phase, distortion, and frequency response of audio amplifiers, using both the sine- and square-wave outputs; video amplifier measurement and response; square-wave modulation of high-frequency signal generators used in waveguide tests, etc. The various outputs can also be used to pulse modulate the horizontal time-base of an oscilloscope when connected to the brightness or Z-axis. See Fig. 7.

Considering the versatility of this calibrator and pulse generator, it is well worth the time and effort involved in building and calibrating such an instrument. —30—



Side view of the scope calibrator and pulse generator shows four coax fittings that provide the outputs of the unit. Pulses, saw-tooth waves, sine waves, and square waves are all available from the device.

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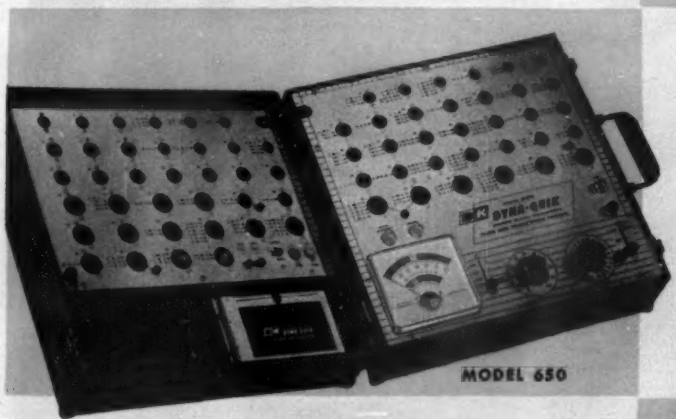

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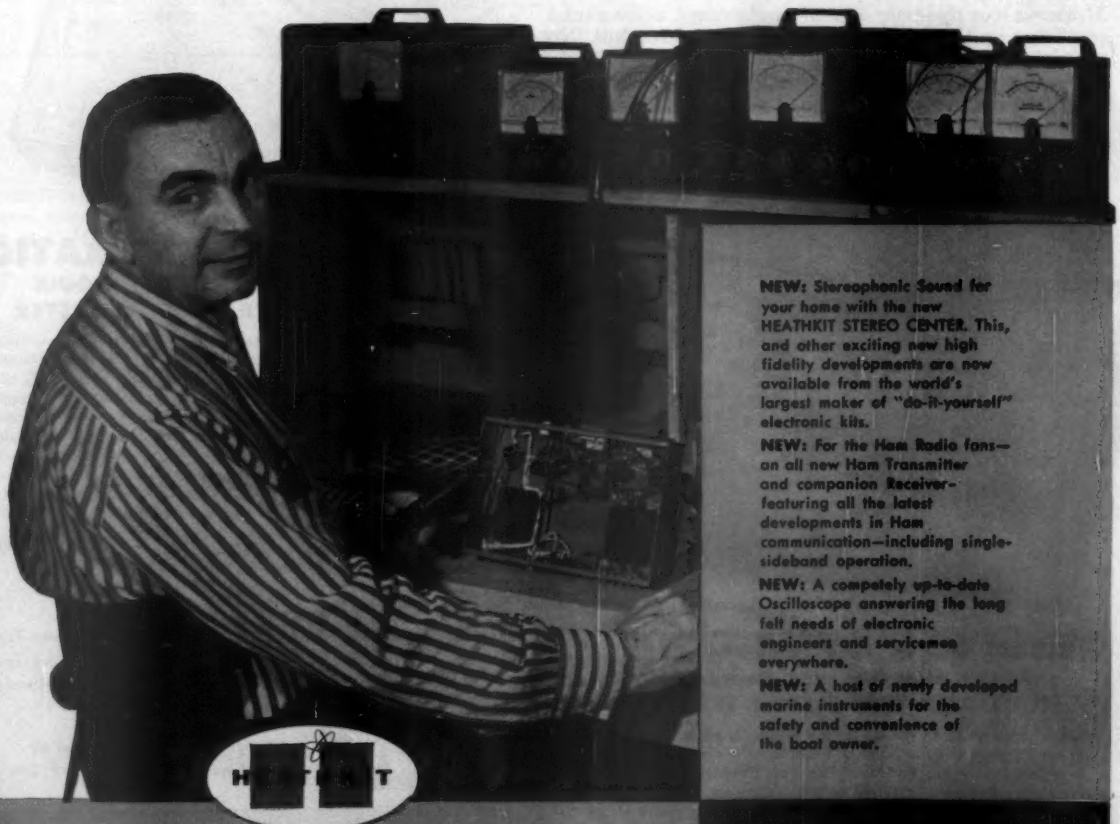

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PROFESSIONAL OSCILLOSCOPE KIT

An exciting development in the Heathkit test instrument line is the introduction of the Heathkit model OP-1 Professional Oscilloscope. Emphasizing complete flexibility in any application, the OP-1 features DC coupled amplifiers and also DC coupled CRT tube un-blanking. The triggered sweep circuit will operate on either internal or external signals and may be either AC or DC coupled. The polarity of the triggering signal may also be selected, and any point on the wave form may be selected for the start of the sweep by using the "triggering level" control. An automatic position is also provided, in which the sweep recurs at a 50 cycle rate, but can be driven over a wide range of frequencies with no additional adjustments. The sweep frequencies are provided by switch-selected base rates of 2 and .2 milliseconds/CM, and 20, 2, and 1 microseconds/CM, in conjunction with a continuously variable 10 to 1 multiplier. Sweep frequencies are calibrated to within 10% at all control settings, and the sweep frequency may be reduced by adding capacity to the "ext. cap" binding post on the front panel. A 5ADP2 flat face CR tube is used for accurate readings on an edge lighted grid screen. A high quality conetic-fernetic CR tube shield prevents stray AC fields from distorting trace. A 12-position vertical attenuator is calibrated in volts-per-CM and the horizontal sweep is calibrated in time-per-CM. Prewired terminal boards are used for rapid, easy assembly of all critical circuits. Simply install and connect the color coded leads. Power supply is transformer operated utilizing silicon diode rectifiers and is fused for protection. Under development for over a year the OP-1 promises outstanding results in any application requiring the use of an oscilloscope.

HEATHKIT OP-1 $179.95

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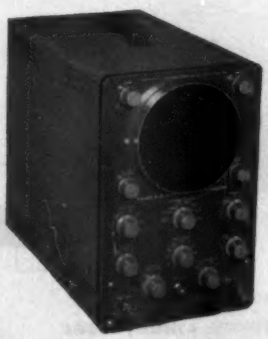

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"EXTRA DUTY" 5" OSCILLOSCOPE KIT

Top quality features at half the cost of ordinary equipment sum up the advantages of this popular kit. Critical observations in your laboratory or shop are handled easily, with clear, sharp pattern displays in every application. Vertical frequency response extends from 3 CPS to 5 mc +1.5 db —5 db without extra switching. Response is down only 2.2 db at 3.58 mc. The Heath patented sweep circuit functions effectively from 10 CPS to better than 500 kc in five steps, giving you 5 times the usual sweep obtained in other scopes. An automatic sync circuit with self-limiting cathode follower provides excellent linearity and lock-in characteristics. Extremely short retrace time and efficient blanking action. Both vertical and horizontal output amplifiers are push-pull and the scope incorporates a 1 V peak-to-peak calibrating source, step attenuated and frequency compensated vertical input, plastic molded capacitors and top quality parts throughout. The 11-tube circuit features a 5UP1 cathode ray tube, and provision is made for Z-axis input for intensity modulation of the beam. Frequency response of the horizontal amplifier is within ±1 db from 1 CPS to 200 kc. Horizontal sensitivity is 0.3 volts RMS per inch. Construction is simplified through the use of two metal circuit boards and precut, cable wiring harness. Shpg. Wt. 22 lbs.

GENERAL PURPOSE 5" OSCILLOSCOPE KIT

For servicing and routine laboratory work this fine kit is a favorite with technicians throughout the country. It incorporates many extras not expected at this low price. Features wide vertical amplifier frequency response, extended sweep generator operation, and improved stability. Frequency response of the vertical amplifier is within ± 3 db from 4 CPS to 1.2 mc. Vertical sensitivity is .09 volts RMS per inch at 1 kc. Sweep generator functions reliably from 20 CPS to over 150 kc. A modern etched circuit board is featured for high stability and reduces assembly time considerably. Standard components are mounted on this board with each position clearly marked preventing wiring errors. Both vertical and horizontal amplifiers are push-pull types. Uses a 5BP1 CRT. Provision for external or internal sweep or sync, built in 1 V peak-to-peak reference voltage and calibrated grid screen. An adjustable "spot shape" control is provided to insure a sharp trace. Input to the vertical amplifiers is through a step attenuated, frequency compensated circuit. The OM-3 is an extremely versatile instrument and has a multitude of practical uses in electronic testing fields. Particularly useful in alignment of television receivers, for testing audio amplifiers and circuits, and checking the quality of modulated RF signals in Ham Radio transmitters. Shpg. Wt. 22 lbs.

Equip Your Service Bench...

HEATHKIT CD-1 **$59.95**

COLOR BAR AND DOT GENERATOR KIT

Colored television is now a reality and as the number of these sets increase the need for a reliable service instrument is apparent. Nothing on the market... in this type of generator has as many features as the CD-1 at such a tremendous price saving. This unit combines two basic color service instruments, a color bar generator, and white dot generator in one versatile portable unit which has crystal controlled accuracy and stability for steady locked-in patterns (requires no external sync leads). Color receivers converged with the CD-1 will still be converged properly on a television program from the station. The 13-tube circuit has been carefully laid out for ease of assembly and provides choice of six different patterns. Produces white-dots, cross hatch, horizontal and vertical bars, ten vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply uses long-life silicon rectifiers. Kit includes three crystals and test lead, plus an information packed instruction manual covering convergence, and screen and background adjustments of a color TV set. Compare with other generators on the market and you will see that this instrument is loaded with extras and top quality all the way through. Shpg. Wt. 13 lbs.

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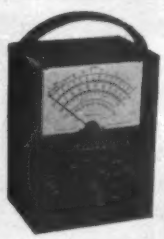

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TV ALIGNMENT GENERATOR KIT

This generator has many special design features for flexible, easy operation and reliability. The all-electronic sweep circuit insures stability and covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. Crystal and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking and phasing control also provided. A truly outstanding number of features at a tremendous price saving. Shpg. Wt. 16 lbs.

SINE-SQUARE GENERATOR KIT

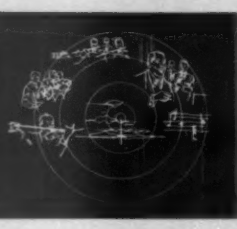
High quality sine and square waves are produced by this generator over a wide range. Frequency response is ±1.5 db from 20 CPS to 1 mc on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Output impedance is 600 ohms on sine wave and 50 ohms on square wave (except on 10 volt range). Square wave rise time less than .15 microseconds. Five-position bandswitch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1 and .1 volts with extra range of .01 volt on sine wave. Shpg. Wt. 12 lbs.

20,000 OHMS/VOLT VOM KIT

This meter is ideal for use in field applications where accuracy is important. Employs a 50 ua 4½" meter, and features 1% precision multiplier resistors for high accuracy. Requires no external power for operation (batteries supplied). Sensitivity is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5,000 volts AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are x 1, x 100 and x 10,000 Covers -10 db to +65 db. Batteries and test leads are also included with this kit. Shpg. Wt. 6 lbs.

HANDITESTER KIT

Small enough to carry with you wherever you go, this fine handitester is ideal for use in portable applications when making tests away from the work bench or as an "extra" meter in the service shop, when the main instruments are occupied. The combination function-range switch simplifies operation. Measures AC or DC voltage from 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000. Top quality precision components employed throughout. Very popular with home experimenters and electricians. Shpg. Wt. 3 lbs.



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Imagine!... Stereophonic sound in your own home. This superbly designed cabinet holds all of your hi-fi stereo equipment and lends striking elegance to your living room. The attractive gold and black panels, trim and hardware brilliantly highlight the overall effect. Rich toned grille cloth, flecked in gold and black, complement the cabinet. The unit has ample room provided for an AM-FM tuner, tape deck, stereo preamplifier, amplifiers, record changer, record storage and speakers. Beautifully grained ¾" solid core Philippine mahogany or select birch plywood is used for construction. The top features a shaped edge and sliding top panel for easy access to the stereo tape deck and stereo preamplifier. Sliding doors are employed for convenient front access to the changer and record storage compartment. All parts of the cabinet are precut and predrilled for simple assembly. The speaker wings and center cabinet may be purchased separately if desired. Note: the kit is delivered equipped with panels precut to accommodate Heathkit components and also blank panels to cut out for your own equipment. Measurements of the individual component areas follow: tape deck and preamplifier area 20¾" L. x 17¾" W. x 10" D., record changer area 21" W. x 16" D. x 9⅜" H., record storage area 22⅝" W. x 14½" H. x 12½" D., speaker wing area (inside) 14" W. x 29½" H. x 15¾" D., AM-FM Tuner area 20½" W. x 5¼" H. x 14" D., amplifier (2 areas) 15¼" W. x 10¾" H. x 13¼" D.

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The increasing sales of the Legato has made more economical quantity production possible so we are passing the savings on to you by offering you this magnificent speaker system at a reduced price. Truly a "queen" among hi-fi speaker systems, the Legato was specially designed to meet and surpass the most stringent requirements of high fidelity sound reproduction. Two 15" Altec Lansing low frequency drivers cover frequencies of 25 to 500 CPS while a specially designed exponential horn with high frequency driver covers 500 to 20,000 CPS. A unique crossover network is built in making electronic crossovers unnecessary. Internal reflections are absorbed by splayed back panel and a 3" fiber glass lining. The Legato emphasizes simplicity of line and form to blend with modern or traditional furnishings. Cabinet construction is ¾" veneer surface plywood in either African mahogany or white birch and measures 41" L. x 22¼" D. x 34" H. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.

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True high fidelity performance at modest cost make this basic speaker system a spectacular buy for any hi-fi enthusiast. The amazing performance of this popular kit is made possible by the use of high quality speakers in an enclosure specially designed to receive them. The cabinet is a ducted port bass reflex type enclosure 11½" H. x 23" W. x 11¾" D. It features an 8" mid range woofer to cover 50 to 1600 CPS and a compression-type tweeter with flared horn covering 1600 to 12,000 CPS. Both speakers are by Jensen. The adjustable flared tweeter horn allows speaker to be used in either upright or horizontal position. The cabinet is constructed of ½" veneer surfaced plywood suitable for light or dark finish of your choice. All wood parts are precut and predrilled for easy assembly. Shpg. Wt. 25 lbs.

Attractive brass tip accessory legs convert SS-2 into attractive consolette. Legs screw into brackets provided. All hardware included. Shpg. Wt. 3 lbs. No. 91-26 $4.95

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HIGH FIDELITY TAPE RECORDER KIT

Popular request for high quality, low cost tape recording and playback facilities have prompted the addition of this fine unit to our line. The TR-1A provides monaural record /playback with fast forward and rewind functions. Incorporates separate erase and combination record /playback heads. Two speeds, 7½ and 3¾ IPS, are selected by changing belt drive. Flutter and wow are held to less than 0.35%. Frequency response at 7½ IPS ±2.0 db 50-10,000 CPS, at 3¾ IPS ±2.0 db 50-65,000 CPS. The extremely simple mechanical assembly is ideally suited to kit construction. One control lever selects all functions on deck, greatly simplifying operation. Mount in vertical or horizontal position. The model TE-1 record /playback tape preamplifier, supplied with the mechanical assembly, provides NARTB playback equalization. A record interlock prevents accidental tape erasure. Recording level is indicated by a 6E5 "magic eye" tube. A two-position input selector switch provides for mike or line input. Separate record and playback gain controls. Filament balance control allows adjustment for minimum hum level. Cathode follower output from playback channel is approximately 600 ohms impedance. Two circuit boards are used for easy assembly. Templates and instructions are provided to cut out panels for mounting. Overall dimensions of tape deck and preamp are 15½" W. x 13½" H. x 8" D. Signal-to-noise ratio is better than 45 db below normal recording level with less than 1% total harmonic distortion. (Tape mechanism not sold separately.) Shpg. Wt. 22 lbs.

TAPE RECORDER ELECTRONICS KIT

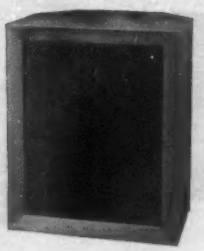
The model TE-1 Electronics Kit can be purchased separately to replace the electronics in your present tape recorder, or used in addition to it for stereo playback of pre-recorded tapes where a second playback channel is required. Circuit may be modified for use with different head types. Shpg. Wt. 9 lbs.

HEATHKIT TR-1A **$99.95**

(Includes tape deck, tape recorder electronics, mike and roll of tape.)

Make Your Own Home Recordings

HEATHKIT TE-1 **$39.95**

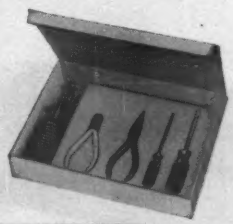


HEATHKIT SS-1B **$99.95**

Fill out the Hi-Fi Range of Your SS-2 Speaker

HEATHKIT SW-1 **$24.95**

Save Time Rewinding Tape



HEATHKIT TK-1 **$9.95**

All The Tools You Need For Building Heathkits

"RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

This is not a complete speaker system in itself, but is designed to extend the range of the SS-2. The SS-1B uses a 15" woofer and a small super tweeter to supply the very high and very low frequencies to fill out the response of the basic SS-2. The SS-2 and SS-1B when used together, form an integrated four speaker system. The SS-2 and SS-1B combination provide an overall response of ± 5 db from 35 to 16,000 CPS. The kit includes circuit for crossover at 600, 1600 and 4,000 CPS. Impedance is 16 ohms and power rating is 35 watts. A control is also provided to limit output of super tweeter. The handsome cabinet measures 29" H. x 23" W. x 17½" D. Constructed of beautiful ¾" veneer surface plywood. Complete step-by-step instructions make this kit easy to build. No woodworking experience required. Shpg. Wt. 80 lbs.

"SPEEDWINDER" KIT

This handy device leaves your tape recorder free for operation while it rewinds tape at the rate of 1200' in 40 seconds. Prevents unnecessary wear to the tape and recorder by eliminating wear against guides and heads. It will handle up to 10½" tape reels as well as 800' reels of 8 and 16 millimeter film. A very useful aid to operators of movie projection equipment. The Heathkit Speedwinder features an automatic shutoff which prevents whipping of tape when it has rewound. A manual shutoff is also provided. An automatic braking device is built in for protection against power failure. Driven by a heavy duty four pole motor. Handsome cabinet is constructed of furniture grade plywood. Step-by-step instructions are provided to make this kit easy to assemble even by one with no experience. Shpg. Wt. 12 lbs.

COMPLETE TOOL SET

A clear illustration of just how easy Heathkit building is. The pliers, diagonal sidecutters, two screw drivers and soldering iron are all the basic tools you need for building practically any Heathkit. Pliers and sidecutters are equipped with insulated rubber handles. The American Beauty soldering iron has a replaceable tip to facilitate cleaning. All the tools are of top quality case hardened steel for rugged duty and long life. With these simple, inexpensive tools in your hand you need not be afraid to tackle the most elaborate kit. The manual included with this handy kit provides you with many useful tips on the use and care of your tools. It shows the all important step of making proper solder connections. A truly worthwhile investment for the beginner in electronic kit building. Shpg. Wt. 3 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • **Benton Harbor 15, Mich.**

Plan Your Hi-Fi System...

HEATHKIT SP-2 **$56.95**

Model SP-1 (monaural) $37.95

Model C-SP-1 (converts SP-1 to SP-2) $21.95

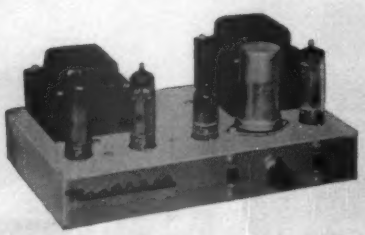
Control both stereo channels simply and conveniently

MONAURAL-STEREO PREAMPLIFIER KIT

This expertly designed preamplifier provides all the controls required for either standard monaural (single channel) or stereo (dual channel) sound reproduction. Features building block design . . . you can start with a basic preamplifier and add a second channel for stereo later on, without rewiring. Second channel plugs in for fast conversion. The complete model SP-2 (stereo) features twelve separate inputs, six on each channel with input level controls. Six dual-concentric controls consist of: two 8-position selector switches, two bass, two treble, two volume level and two loudness controls, a scratch filter switch and a 4-position function switch (separate on-off switch). The function switch provides settings for stereo, two-channel mix, channel A or B for monaural use. Inputs consist of tape, mike, mag phono and three high-level inputs. Tape input has NARTB equalization and input selector provides for RIAA, LP, 78 record compensation. EF86 tubes are used in the input stages along with hum balance controls to assure low hum and noise. Two cathode follower outputs with level controls provided in addition to two separate tape outputs for stereo recording. A remote balance control with twenty feet of cable allows balancing the stereo system from listening position. Construction is greatly simplified through the use of two printed circuit boards (one in each channel) and encapsulated printed circuits. The beautiful vinyl clad steel cover has leather texture in black with inlaid gold design. Built-in power supply.

HEATHKIT WA-P2 **$19.75**

Finger-tip controls for your operating convenience



HEATHKIT UA-1 **$21.95**

A low cost versatile performer

"MASTER CONTROL" PREAMPLIFIER KIT

Designed as a control center for basic amplifiers the WA-P2 provides you with true high fidelity performance for the finest audio systems. Five switch-selected inputs accommodate a record changer, tape recorder, AM-FM tuner, TV receiver, microphone, etc., each with level control. Provision is also made for a tape recorder output. Ideal for "remote" installations, the WA-P2 features a low impedance cathode-follower output circuit allowing greater length of output lead. Full frequency response is obtained within ±1½ db from 15 to 35,000 CPS and will do full justice to the finest available program sources. Equalization is provided for records through separate turnover and rolloff switches for LP, RIAA, AES, and early 78's. A special hum balance control allows setting for minimum hum level. Power for operation is required from basic amplifier or external source. Shpg. Wt. 7 lbs.

"UNIVERSAL" 12-WATT AMPLIFIER KIT

A true high fidelity performer in every sense of the word, the UA-1 makes an ideal basic amplifier for any hi-fi system and is a perfect addition to gear your present hi-fi system for stereo sound. Uses 6BQ5/EL84 push-pull output tubes for less than 2% harmonic distortion throughout the entire audio range (20 to 20,000 CPS) at full 12 watt output. The on-off switch is located right on the chassis and an octal socket is provided for connecting a preamplifier for remote control operation. The specially designed output transformer provides excellent stability and frequency response. Taps for 4, 8 and 16 ohm speakers, with switched damping for "unity" or "maximum" on the 16-ohm tap. An input level control is provided for use in wired music systems where a preamplifier is not required. This versatile unit is the latest addition to the fine line of Heathkit basic amplifiers. Shpg. Wt. 13 lbs.

With Flexible Heathkit Components

HEATHKIT

DELUXE AM-FM TUNER KIT

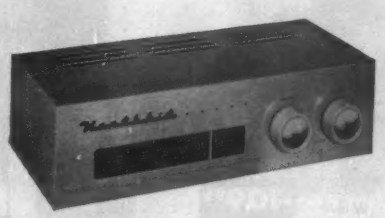
Outstanding features in both styling and circuitry are combined in this 16-tube deluxe AM-FM combination tuner to bring you the very finest in program sources, for your listening enjoyment. Features include three circuit boards for easy construction and high stability—prewired, prealigned FM front end—built-in AM rod antenna—tuning meter—AFC (automatic frequency control) with on-off switch and flywheel tuning. AM and FM circuits are separate and individually tuned making it ideal for stereo applications. Cathode follower outputs with individual controls are provided for both AM and FM. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. The unique IF limiter design automatically provides the number of limiting and IF stages required for smooth non-flutter reception. The silicon diode power supply is extremely conservatively rated and is fuse protected assuring long service life. A tuning meter shows when the station is tuned-in for clearest reception on AM or FM. Use of three circuit boards greatly simplifies construction of circuit, you do only a minimum of wiring. All IF transformers and coils are prealigned so it will be ready to operate as soon as construction is completed. Appearance of this top-quality unit is further enhanced by the vinyl-clad steel cover in black with inlaid gold design. A multiplex jack is provided for addition of converter unit to receive multiplex stereo broadcasts on FM. A top dollar value.

HEATHKIT PT-1 $89.95

A deluxe AM-FM tuner combination loaded with extras!

HEATHKIT BC-1A $26.95

Wide range broadcast reception



HEATHKIT FM-3A $26.95

Enjoy static-free FM entertainment

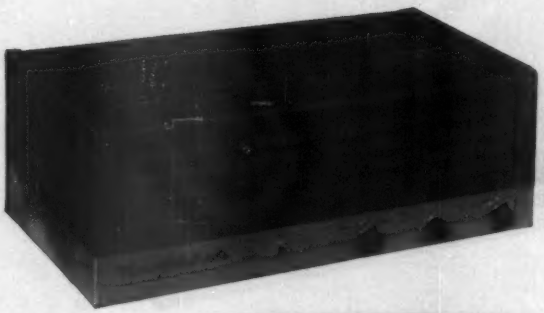
HIGH FIDELITY AM TUNER KIT

This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuit features broad bandwidth to assure low signal distortion. Audio response is ±1 db from 20 CPS to 9 kc, with 5 db of pre-emphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent and the tuner covers the entire broadcast band from 550 to 1600 kc. Quiet performance is assured by a 6 db signal-to-noise ratio at 2.5 uv. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

HIGH FIDELITY FM TUNER KIT

FM programming, your least expensive source of high fidelity will provide you with years of real enjoyment. This beautifully styled FM tuner features broad-banded circuits for full fidelity and better than 10 uv sensitivity for 20 db of quieting to pull in stations with clarity and full volume. Covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit, making special alignment equipment unnecessary. Edge-lighted glass slide rule dial for easy tuning. You need not wait to have FM in your home at this low price. Shpg. Wt. 8 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • **Benton Harbor 15, Mich.**



HEATHKIT W-7M **$54.95**

55 watts of hi-fi power at only $1 per watt

★ BEAUTIFULLY STYLED IN BLACK AND GOLD

★ UNITY OR MAXIMUM DAMPING

"EXTRA PERFORMANCE" 55 WATT HI-FI AMPLIFIER KIT

Another Heathkit first! An honestly rated high power amplifier with many top quality features at less than a dollar per watt. Full audio output is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Unique paired output connections permit instant switch selection of "unity" or "maximum" damping factors for all 4, 8 or 16 ohm speakers. Each output has an optimized current feedback circuit for unity damping so that there will be no compromise in performance when any of the impedances is used. This current feedback circuitry is entirely shorted out when not in use to obtain the highest possible damping factor. Features include level control and "on-off" switch right on the chassis plus provision for remote control from preamp, etc. Famous "bas-bal" circuit conveniently balances EL-34 output tubes. These heavy duty push-pull tubes operate into a high quality tapped-screen transformer designed especially for this unit. A 70-volt output on the transformer provides for P.A. or large music systems. The silicon diode power supply features a protection device that controls current until tubes have warmed up, greatly increasing service life of all components. The stylish black and gold case measures 6" H. x 8½" D. x 15" W. Convenient pilot light on the chassis. Thoughtful circuit layout makes this kit easy to build. Dollar for watt you can't beat this buy. Shipped express only. Shpg. Wt. 28 lbs.

HEATHKIT W-6M **$109.95**

Plenty of Reserve Power Without Distortion

"HEAVY DUTY" 70-WATT HI-FI AMPLIFIER KIT

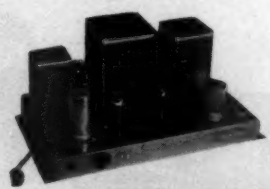
Here is an amplifier that will provide the extra "push" needed to drive any of the fine speaker systems available today, for truly fine performance at any power level. Silicon-diode rectifiers are used to assure long life and a heavy duty transformer gives you extremely good power supply regulation. Variable damping control provides optimum performance with any speaker system. Quick change plug selects 4, 8 and 16 ohms or 70 volt output and the correct feedback resistance. Frequency response at 1 watt is from 5 CPS to 80 kc with controlled HF rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 CPS and IM distortion is below 1%, 60 and 6,000 CPS. Hum and noise 88 db below full output. Metered balance circuit. Designed especially for easy assembly and years of dependable service. Shipped express only. Shpg. Wt. 52 lbs.

HEATHKIT W-5M **$59.75**

Top-Flight Performance for the Critical Listener

25-WATT HI-FI AMPLIFIER KIT

Considered top value in its power class by leading independent research organizations, the W-5M incorporates all the design features required by the super critical listener. Features include a specially designed Peerless output transformer and KT66 tubes. The circuit is rated at 25 watts and will follow instantaneous power peaks of a full orchestra up to 42 watts. A "tweeter saver" suppresses high frequency oscillation and a new type balancing circuit facilitates adjustment of the "dynamic" balance between output tubes. Frequency response is ±1 db from 5 CPS to 160,000 CPS at 1 watt and within 2 db from 20 to 20,000 CPS at full 25 watts output. Harmonic distortion is less than 1% at 25 watts and IM distortion is 1% at 20 watts (60 and 3,000 CPS, 4:1). Hum and noise are 99 db below 25 watts for truly quiet performance. Rich black and gold colored styling. Shipped express only. Shpg. Wt. 31 lbs.



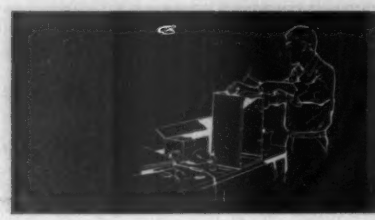
HEATHKIT W4-AM **$39.75**

Faithful Sound Reproduction with Minimum Investment

20-WATT HI-FI AMPLIFIER KIT

This fine amplifier will amaze you with its outstanding performance. It features a true Williamson circuit with extended frequency response, low distortion, and low hum levels. Enjoy true hi-fi with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-Standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extends from 10 CPS to 100 kc within ±1 db at 1 watt assuring you of full coverage of the audio range. Clean, clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms to match the speaker system of your choice. An outstanding performer, this investment will bring you years of listening enjoyment. Shipped express only. Shpg. Wt. 28 lbs.

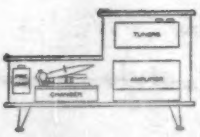
All basic amplifiers recommended for use with model WA-P2, SP-1 or SP-2 preamplifiers



Easy to Buy - Easy to Build - Easy to Use...

HEATHKIT
CE-1
$43.95 each

CONTEMPORARY
Model CE-1B Birch
Model CE-1M Mahogany

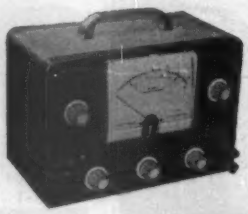


TRADITIONAL
Model CE-1T Mahogany

Combine all your Hi-Fi equipment in this attractive cabinet

CHAIRSIDE ENCLOSURE KIT

This Chairside Enclosure lets you combine all of your hi-fi equipment into one compact control center and, at the same time add a beautiful piece of furniture to your home. The CE-1 is designed to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier along with the majority of record changers which will fit into the space provided. Adequate room is available in the rear of the unit to house any of the Heathkit amplifiers designed to operate with the WA-P2. The enclosure is flexible enough to give you a large choice in component installation. If only one tuner and the preamplifier are used, the two units can be installed in the tilt-out drawer, or if more convenient, either unit can be placed in the space provided in front of the changer compartment. The tilt-out shelf can be installed on either right or left side and the lift-top lid is similarly designed to lift from either side depending on your choice during construction. Good ventilation is achieved through appropriately placed slots in the bottom and back of the enclosure. Overall dimensions are 18"W. x 24" H. x 35½" D. The changer compartment measures 17¾" L. x 16" W. x 9⅜" D. All parts are precut and predrilled for easy assembly and attractive hardware is supplied to match each style. The contemporary cabinet is available in either mahogany or birch and the traditional cabinet is available in mahogany only. Furniture grade plywood can be finished to your taste. Shpg. Wt. 46 lbs.

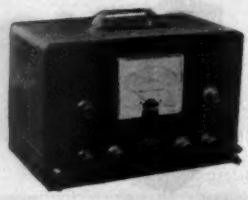


HEATHKIT **AG-9A** **$34.50**

Your own source of Hi-Fi audio signals

HEATHKIT **AA-1** **$49.95**

3 Audio test instruments in one compact unit



HEATHKIT **HD-1** **$49.50**

Check amplifier distortion quickly

AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals from 10 CPS to 100 kc. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1, 3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 CPS. Shpg. Wt. 8 lbs.

AUDIO ANALYZER KIT

Complete high fidelity testing facilities are yours in the AA-1. It combines the functions of three separate instruments; an AC VTVM, audio wattmeter and a complete IM analyzer with filters and high and low frequency oscillators built in. VTVM ranges are: 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Db scale reads from −65 to +52 dbm. Wattmeter ranges are: .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100% full scale. Provides internal load resistors of 4, 8, 16 or 600 ohms. Combining and consolidating functions reduces the number of test leads and controls required for the same test. Complete instructions are provided for easy assembly, also valuable information on use of instrument. Shpg. Wt. 13 lbs.

HARMONIC DISTORTION METER KIT

Valuable in both designing and servicing of audio circuits, the HD-1 used with an audio signal generator, will accurately measure harmonic distortion at any or all frequencies between 20 and 20,000 CPS. Distortion is read on panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Full scale voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio is measured on a separate meter scale calibrated in db. Features high input impedance (300,000 ohms) and 1% precision resistors in the VTVM voltage divider circuit for excellent sensitivity and accuracy. High quality components insure years of dependable service. Complete instructions provided for easy assembly and operation. Shpg. Wt. 13 lbs.

Heathkits are Your Best Dollar Value

HEATHKIT

TRANSISTOR PORTABLE RADIO KIT

The overwhelming sales of this outstanding transistor portable have made a substantial price reduction possible . . . in addition, an all new plastic molded case adds the finishing touch to the exceptional circuitry. Six name-brand (Texas Instrument) transistors are used for extra good sensitivity and selectivity. The 4" x 6" PM speaker with heavy magnet provides excellent tone quality. Use of this large speaker and roomy chassis make it unnecessary to crowd components adding greatly to the ease of construction. Transformers are prealigned so it is ready for service as soon as construction is completed. A touchup in alignment is easily accomplished on a station by following simple instructions in manual. Alignment tool furnished. Has built-in rod-type antenna for reception in all locations. Six standard size "D" flashlight cells are used for extremely long battery life (between 500 and 1000 hours) and they can be purchased almost anywhere. Cabinet is two-tone blue molded plastic with pull-out carrying handle. Dimensions are 9½" L. x 7¼" H. x 4" D. Shpg. Wt. 6 lbs.

Model XR-1-L: Identical to XR-1-P except in genuine leather case. Rich, warm sun-tan tone. Leather carrying strap included. Shpg. Wt. 7 lbs.

Leather Case: can be purchased separately if desired. Fits all XR-1P's and XR-1's. No. 93-1. Shpg. Wt. 3 lbs. $6.95.

MODEL XR-1-L
$34.95

HEATHKIT XR-1-P **$29.95**

Newly designed plastic case . . . new low price!

★ 4" X 6" SPEAKER FOR "BIG SET" TONE
★ LONG BATTERY LIFE (500 to 1000 Hours)

HEATHKIT CT-1 **$7.95**

Test condensers right in the circuit

HEATHKIT DF-1 **$54.95**

Pin-point your exact location

HEATHKIT FD-1 **$35.95** each
(6 volt model FD-1-6)
(12 volt model FD-1-12)

Detects gas fumes

HEATHKIT MC-1 **$42.95**

Save your boat batteries

IN-CIRCUIT CAPACI-TESTER KIT

Check most capacitors for "open" or "short" right in the circuit with this handy kit. Detects open capacitors from about 50 mmf up, not shunted by an excessively low resistance value. Checks shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage nor check electrolytic condensers.) Employs a 60-cycle frequency for the short test and a 19 megacycle frequency for the open test. Uses electron beam "eye" tube for quick indication. Test leads included. Shpg. Wt. 5 lbs.

TRANSISTOR RADIO DIRECTION FINDER KIT

This transistor radio compass will double as a portable radio. Covers the standard broadcast band from 540 to 1600 kc. Ideal for use aboard boats and also on land by hunters, hikers, etc. A directional high-Q ferrite antenna rotates from the front panel to obtain a fix on a station. A 1 ma meter serves as null and tuning indicator. Prealigned IF transformers—six transistor circuit. Powered by tiny 9-volt battery with spare included. Dimensions 7½" W. x 5⅜" H. x 5⅜" D. Shpg. Wt. 5 lbs.

FUEL VAPOR DETECTOR KIT

Protect your boat and passengers against fire and explosion with one of these fuel vapor detector kits. Indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot lamp shows when the detector is operating. Easy to build and install, even by one not having previous experience. Operates from your boat battery. The kit is complete with heavy-duty neoprene insulated cable and includes spare detector unit. Shpg. Wt. 4 lbs.

MARINE CONVERTER KIT

Charge 6 or 12 volt batteries with this marine converter and battery charger. A panel mounted 25 ampere meter continuously monitors the charging current. Moisture and fungus proofed for rugged marine use. Convection cooling prevents unsafe temperature rise. The MC-1 has no moving parts, tubes nor blowers to wear out or break. Mounting brackets are supplied for easy installation on any boat. Ideal for keeping batteries fully charged or to supply extra current for appliances. Shpg. Wt. 16 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • Benton Harbor 15, Mich.

HEATHKIT TX-1 $229.50

Complete Versatility for Top-Notch Amateur Communications

★ NEWLY DESIGNED VFO—ROTATING SLIDE RULE DIAL
★ MODERN STYLING—PROVISION FOR SSB ADAPTER

"APACHE" HAM TRANSMITTER KIT

Fresh out of the Heath Company laboratories, the brand-new "Apache" model TX-1 ham transmitter features modern styling and the latest in circuitry for extra fine performance. The "Apache" is a high quality transmitter operating with a 150 watt phone input and 180 watt CW input. In addition to CW and phone operation, built-in switch selected circuitry provides for single-sideband transmission through the use of a plug-in external adapter. These SSB adapters will be available in the near future. A compact, stable and completely redesigned VFO provides low drift frequency control necessary for SSB transmission. A slide rule type illuminated rotating VFO dial with vernier tuning provides ample bandspread and precise frequency settings. The bandswitch allows quick selection of the amateur bands on 80, 40, 20, 15 and 10 meters. (11M with crystal control). This unit also has adjustable low level speech clipping and a low distortion modulator stage employing two of the new 6CA7/EL-34 tubes in push-pull class AB operation. Time sequence keying is provided for "chirpless" break-in CW operation. The final amplifier is completely shielded for greater TVI protection and transmitter stability. Die-cast aluminum knobs and front panel escutcheons add to the attractive styling of the transmitter. Pi network output coupling matches antenna impedances between 50 and 72 ohms. Shpg. Wt. 107 lbs.

$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified

HEATHKIT DX-20 $35.95

An Ideal Code Transmitter

HEATHKIT DX-100 $189.50

You'll be Proud to Own This Outstanding Performer

HEATHKIT DX-40 $64.95

Phone & CW Facilities at Low Cost

DX-20 CW TRANSMITTER KIT

Designed especially for CW work, the DX-20 features high efficiency at low cost. An ideal rig for the novice or advanced-class CW operator. Plate power input is 50 watts, and covers 80, 40, 20, 15, 11 and 10 meters with single knob bandswitching. Features a single 6DQ6A tube in the final amplifier stage and a 6CL6 as a crystal oscillator. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long service life. Complete shielding to minimize TVI. Removable metal pull-out plug on left end of cabinet provides access for crystal changing. Very easy to build with complete instructions supplied. Shpg. Wt. 19 lbs.

DX-100 PHONE AND CW TRANSMITTER KIT

Well known for its high quality and fine performance the DX-100 features a built-in VFO, modulator, and power supply, complete shielding to minimize TVI, and a pi network coupling to match impedances from 50 to 600 ohms. RF output is in excess of 100 watts on phone and 120 watts on CW, for clean strong signals on all ham bands from 10 to 160 meters. Single knob bandswitching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as potted transformers, silver-plated or solid coin silver switch terminals, aluminum-heat dissipating caps on the final tubes, copper plated chassis, etc. Shpg. Wt. 107 lbs.

$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified.

DX-40 PHONE AND CW TRANSMITTER KIT

An outstanding buy in its power class the DX-40 provides both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 75 watt plate power input on CW, or controlled carrier modulation peaks up to 60 watts for phone operation. Modulator and power supplies are built in and single-knob bandswitching is combined with the pi network output circuit for complete operating convenience. Complete shielding to minimize TVI. Provision is made for three crystals. A four-position switch selects any of the three crystals or a jack for external VFO. Crystal sockets are reached through access door in rear of cabinet. High quality D'Arsonval movement panel meter. Shpg. Wt. 25 lbs.

Choose from a wide variety of Heathkits

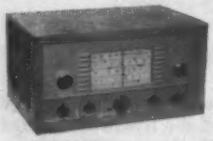
DUAL-CHASSIS 20 WATT HI-FI AMPLIFIER KIT

Model W3-AM
(Shpg. Wt. 29 lbs.)
$49.75

12" UTILITY SPEAKER

Model 401-6
(Shpg. Wt. 7 lbs.)
$7.50

ALL-BAND RADIO KIT



Model AR-3
(Shpg. Wt. 12 lbs.)
$29.95
(less cabinet)

CRYSTAL RADIO KIT

Model CR-1
(Shpg. Wt. 3 lbs.)
$7.95

BROADCAST BAND RADIO KIT

Model BR-2
(Shpg. Wt. 10 lbs.)
$18.95
(less cabinet)

ELECTRONIC CROSSOVER KIT

Model XO-1
(Shpg. Wt. 6 lbs.)
$18.95

"Q" MULTIPLIER KIT

Model QF-1
(Shpg. Wt. 3 lbs.)
$9.95

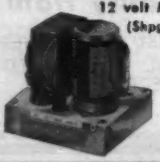
"AUTOMATIC" CONELRAD ALARM KIT

Model CA-1
(Shpg. Wt. 4 lbs.)
$13.95

GRID DIP METER KIT

Model GD-1B
(Shpg. Wt. 4 lbs.)
$21.95

VIBRATOR POWER SUPPLY KIT



6 volt Model VP-1-6
12 volt Model VP-1-12
(Shpg. Wt. 4 lbs.)
$7.95 ea.

VARIABLE FREQUENCY OSCILLATOR KIT

Model VF-1
(Shpg. Wt. 7 lbs.)
$19.50

PROFESSIONAL RADIATION COUNTER KIT

Model RC-1
(Shpg. Wt. 8 lbs.)
$79.95

ISOLATION TRANSFORMER KIT

Model IT-1
(Shpg. Wt. 9 lbs.)
$16.50

ELECTRONIC SWITCH KIT

Model S-3
(Shpg. Wt. 8 lbs.)
$21.95

REGULATED POWER SUPPLY KIT

Model PS-3
(Shpg. Wt. 17 lbs.)
$35.50

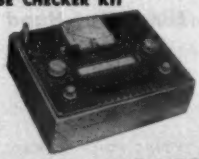
VOLTAGE CALIBRATOR KIT

Model VC-3
(Shpg. Wt. 4 lbs.)
$12.50

DIRECT-READING CAPACITY METER KIT

Model CM-1
(Shpg. Wt. 7 lbs.)
$29.50

TUBE CHECKER KIT



Model TC-2
(Shpg. Wt. 12 lbs.)
$34.95

EASY TIME PAYMENTS
AVAILABLE FOR YOUR CONVENIENCE . . .

Any order totaling $90 or more can be paid for in small monthly payments (send for complete details).

RESISTANCE SUBSTITUTION BOX KIT

Model RS-1
(Shpg. Wt. 2 lbs.)
$5.50

CONDENSER SUBSTITUTION BOX KIT

Model CS-1
(Shpg. Wt. 2 lbs.)
$5.50

CATHODE RAY TUBE CHECKER KIT

Model CC-1
(Shpg. Wt. 10 lbs.)
$24.95

LABORATORY RF GENERATOR KIT

Model LG-1
(Shpg. Wt. 16 lbs.)
$48.95

"Q" METER KIT

Model QM-1
(Shpg. Wt. 14 lbs.)
$44.50

DECADE CONDENSER KIT

Model DC-1
(Shpg. Wt. 3 lbs.)
$16.50

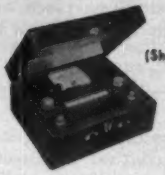
DECADE RESISTANCE KIT

Model DR-1
(Shpg. Wt. 4 lbs.)
$19.50

...to Fill Your Exact Needs

HEATHKIT

PORTABLE TUBE CHECKER KIT



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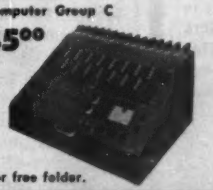

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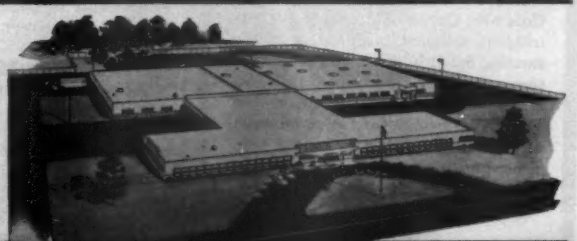

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Hi-Fi-Audio Product Review

CROSSOVER NETWORK

Olson Radio Warehouse, Inc., 260 S. Forge St., Akron 8, Ohio is now offering a new variable-control crossover network for use with matched or unmatched three-way speaker system.

This new unit in the "Shield" line can be used with any set of three 8-ohm speakers or speakers of mixed impedances may be connected to the

unit. A universal terminal strip allows the internal network to be connected into the circuit to compensate for unequal impedances.

Housed in a metal cabinet with gold panel and contrasting black trim and knobs, the crossover has separate variable controls to allow mid-range speakers and tweeters to be adjusted to suit individual tastes. The device is said to stop tweeter blast and coloration due to uncontrolled speaker output. Crossover frequencies are 500 and 3300 cps. The over-all size is 6" x 4½" x 3".

Write the distributor direct for any additional details required on the No. VC-208 crossover.

TRANSISTORIZED TAPE RECORDER

Kingdom Products Ltd., 514 Broadway, New York 12, N. Y. has just introduced a transistorized tape recorder that weighs only four pounds.

The new "Fi-Cord" has a frequency range of 50 to 12,000 cps ± 3 db. The instrument has two speeds, 1⅞ and 7½ ips. It is completely battery operated

and comes with a specially developed charger which permits the four miniature batteries to be recharged simultaneously. A recharge takes a few hours.

The program material can be monitored by means of a small earpiece, or stethophone. The unit also includes a built-in loudspeaker.

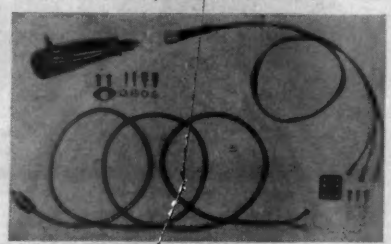
The instrument is housed in a padded leatherette case which measures 9⅝" x 5" x 2⅝" and comes complete with dynamic microphone which has an "on-off" switch that also controls the motor. If desired, a studio microphone can be used when critical performance is required.

Write the manufacturer for full specifications and price.

GARRARD CONVERSION KIT

All recent model *Garrard* record players may now be converted to stereo by means of the new conversion kit being offered by *Garrard Sales Corporation*, Port Washington, N. Y.

Although all current record players from the company are fully wired for stereo, this new kit will enable the owners of Models RC-88, RC-98, RC-121, RC-122/II, and T mk II to con-



vert their units. The kit consists of a female connector wired with two leads for the tone arm, a complete audio cable with plug for the second amplifier, a new stereo shell in which to mount the cartridge, hardware, and complete step-by-step instructions. No soldering operations are required.

The Model SCK-1 will convert all of the above-mentioned models except the RC-122/II. The conversion kit for this unit has been designated as the Model SCK-2.

STEREO PREAMP KIT

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now marketing a new stereo preamplifier, the KT-600, which features unique stereo and monaural control-center facilities.

The instrument includes a dual (input and output) bridge control for obtaining accurate balance of the two stereo channels by means of an audible, sharp null. A "third channel" output is provided to drive a third-channel amplifier and speaker for eliminating "hole-in-the-middle" and "ping-pong" effects. A control is available which acts as a volume control for this third channel or optionally

supplies variable amounts of cross-feed between the two channels to eliminate "ping-pong" effects when using only two speakers.

Other features include tape head equalization for the new 3.75 and 7.5 ips half-track stereo tapes; a new clutch-type master gain control; separate turnover and roll-off controls providing 24 positions of equalization on each channel; inputs for both magnetic and ceramic, crystal, or capacitive cartridges; separate input level controls for each channel, etc.

The company will supply complete technical specifications and price information upon request.

"DYNAKIT" STEREO CONTROL

Complete stereo control facilities can be added to a pair of "Dynakit" preamplifiers with the new DSC-1 stereo control unit being offered by *Dynaco Inc.*, 617 N. 41st, Philadelphia 4, Pa.

The kit, which can be assembled in less than one hour, incorporates all the features required for optimum usage of a combined stereo-monaural hi-fi system and introduces no noise or distortion.

In addition to the conventional dual volume control, the DSC-1 includes a balance control to equalize inter-channel levels, loudness compensation with a disabling switch, a channel reversing switch, and a dual tape monitor switch. A unique auxiliary control is the "blend" control which permits mixing the stereo channels in controllable proportion. This allows the user to fill in "the hole-in-the-middle." It also allows the reproduction of stereo program sources through monaural systems so that stereo discs can be played monaurally without the need to change the cartridge hookup.

The DSC-1 matches the firm's preamp in decor. It measures 3¾" x 6" x 5½". Descriptive literature on this new kit is available from the manufacturer on request.

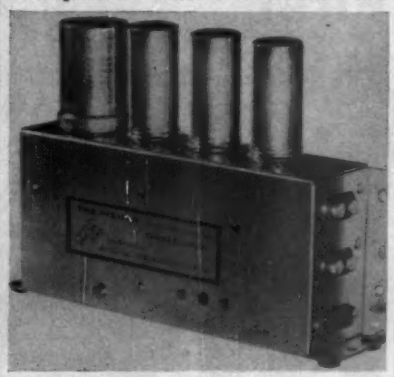
STEREO PREAMP-EQUALIZER

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. has just introduced a single-chassis, self-contained and self-powered stereophonic preamp-equalizer as its Model PR-66.

Designed for remote operation, the unit has no controls. It provides the necessary preamplification for low-level stereophonic cartridges and the correct equalization for the new stereo discs. With a simple modification, the PR-66 may be used as a preamp-equalizer for direct connection from stereo tape playback heads or as a two-channel preamp for two microphones.

Monaurally, the PR-66 serves as a two-channel preamp for two low-level

monaural phono cartridges, one monaural phono cartridge and a monaural tape playback head, or one or two microphones. There is a total of two



inputs and two outputs and an a.c. hum-balance potentiometer.

Over-all dimensions are 8" wide, 17⅛" deep, and 5½" high. Write the manufacturer for additional details.

OXFORD THREE-WAY SYSTEM

Oxford Components, Inc., 556 W. Monroe St., Chicago 6, Ill. is now offering a new three-way speaker system which comes complete with bass reflex enclosures.

The new cabinets feature double-duty design in that they can be used either horizontally or vertically. To match the decor of any room, both

tapered legs and bar runners are provided at no extra cost. The cabinets, which are available in red mahogany, cherry, or blonde oak, are finished on all four sides.

The cabinets house the company's 3-speaker system with crossover network. The system includes a 12" woofer, 8" mid-range, and 3½" tweeter.

For further information, write the company direct.

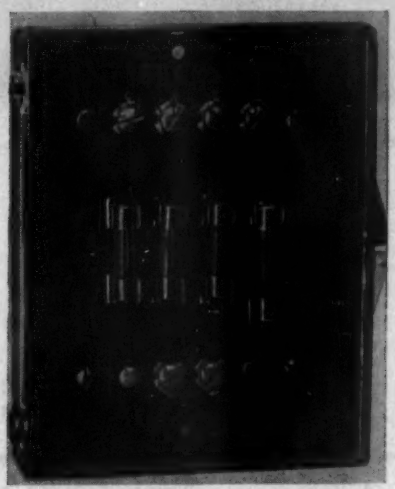
"SPEAKER SAVER"

ProSound Corporation, 175 Fifth Ave., New York 10, N. Y. is currently introducing its compact "Gramercy Speaker-Saver" which is designed to prevent speaker voice-coil failure caused by amplifier overloads, faulty wiring, switching transients, and amplifier failure.

The unit is wired to accommodate speakers whose voice-coil impedance is low-efficiency 4 ohms, 4 ohms, 8 ohms, and 16 ohms. Instrument fuses and hardware are mounted on a phenolic board to insure electronic isolation. The black polystyrene box with clear

crystal door houses the fuse assembly and is drilled so that it may be mounted directly on the rear of the speaker enclosure or near the amplifier.

Marked terminal strips indicate the correct connections for the amplifier



and speaker. Over-all dimensions are 3¾" x 4¾" x 1⅛". Write the company for a data sheet on this unit.

AUDIO CATALOGUES

HI-FI SPEC SHEETS

The Specialty Electronic Components Department of *General Electric Company*, West Genesee St., Auburn, N. Y. has announced the availability of spec sheets on four of its hi-fi components.

The publications are: EP-581 two-page data sheet on the "Stereo Classic" Model TM-2G compatible stereophonic and monaural tone arm; EP-588 four-page brochure covering the "Stereo Classic" Model LH-6 and Model LK-6 series extended-bass bookshelf speaker systems; and the EP-593 two-page sheet on the "Stereo Classic" Model EQ-1 series equipment cabinet.

Write the department direct for any or all of these publications. Please specify the spec sheet numbers as indicated.

BELL'S HI-FI HANDBOOK

Bell Sound Systems, Inc., 555 Marion Road, Columbus, Ohio has issued a 24-page booklet which covers the firm's complete line of high-fidelity components.

Containing photographs and complete specs, the catalogue is being offered without charge. Included in the line described and pictured in Catalogue 101 are amplifiers, tape transports, and tuners in addition to the company's stereo line.

Two special sections of the handbook are devoted to questions about high-fidelity and stereo to help readers plan their own home installations.

Those requesting copies of the handbook will also receive a complete listing of dealers where the components described in the catalogue may be seen and tested. —30—

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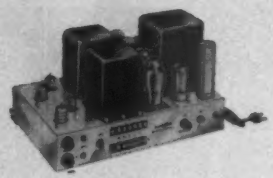
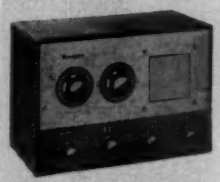
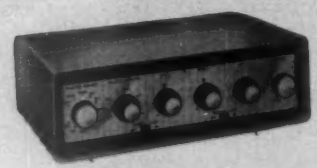


knight-kit 60-Watt Stereo Hi-Fi Amplifier Kit.... Model Y-777 **$84.50**



knight-kit "Space Spanner" 2-Band Receiver Kit..... Model Y-259 **$18.95**



knight-kit Stereo Deluxe Preamp Kit..... Model Y-776 **$62.50**

knight-kit 12-Watt Hi-Fi Amplifier Kit..... Model Y-784 **$19.95**
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knight-kit "Ranger III" AC-DC Radio Kit..... Model Y-736 **$16.95**

knight-kit "Span-Master" 4-Band Receiver Kit..... Model Y-258 **$24.95**

knight-kit "Ranger" Clock-Radio Kit..... Model Y-737 **$24.95**

knight-kit "Ranger" Radio-Intercom Kit..... Model Y-739 **$27.50**

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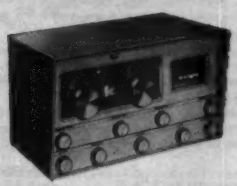
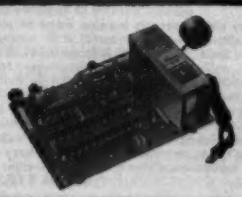


knight-kit Amateur Communications Receiver...Model Y-726 $104.50

knight-kit "400" Tube Checker Kit.....Model Y-707 $19.95



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Within the Industry

(*Continued from page 24*)

Sylvania Electric Products Inc.; H. Leslie Hoffman, *Hoffman Electronics Corp.*; Robert C. Sprague, *Sprague Electric Co.*; Leslie F. Muter, *The Muter Co.*; Robert S. Bell, *Packard-Bell Electronics Corp.*; S. R. Curtis, *Stromberg-Carlson*, a division of *General Dynamics Corp.*; C. Russell Cox, *Andrew Corp.*; Russell E. Cramer, Jr., *Radio Condenser Co.*; A. L. Chapman, *CBS-Hytron*; George T. Scharffenberger, *Kellogg Switchboard and Supply Co.*; and D. R. Hull, ex-officio, *Raytheon Manufacturing Co.*

• • •

JOE RAMER has assumed new duties as chief engineer, engineering department, *Heath Company*, a subsidiary of *Daystrom, Inc.*

Formerly engineering advisor, Mr. Ramer's line of administrative authority will extend directly to all senior engineers, project engineers, technicians, and engineering department supporting activity. He will report to the director of engineering.

Prior to joining the organization he was engaged in electronic development for the National Bureau of Standards and later headed the Fuze Department, U. S. Naval Ordnance Laboratory where he supervised highly classified electronic work for the government.

During World War II he served as a senior engineer in the Navy Radar Development Program. Mr. Ramer has been in the electronics field for over twenty years, fifteen of them with the U. S. Government.

• • •

STEPHEN J. WELSH has been appointed to the new position of manager of marketing for high-fidelity components in *General Electric Company's* specialty electronic components division . . . *CBS-Hytron* has named **FRANK A. SULLIVAN** semiconductor general sales manager . . . Consolidation of all sales and marketing activities for the *Westinghouse* television-radio division under **C. J. URBAN**, marketing manager, has been made known . . . **DR. WILLIAM J. PIETENPOL** is now vice-president and general manager of the semiconductor division of *Sylvania Electric Products Inc.* . . . **JOHN A. RHOADS** has joined *Packard-Bell Electronics Corp.* as director of engineering in the technical products division . . . **RCA** has announced three appointments in the engineering department of the semiconductor and materials division. **E. V. DALE** has been named manager, modules engineering; **DR. F. E. VINAL** is now manager, materials engineering; and **D. H. WAMSLEY** becomes manager, semiconductor engineering . . . **FRANK D. LINTERN** has joined *Jensen Mfg. Co.* as assistant sales manager of the dis-

tributor division . . . *Sylvania Home Electronics*, a division of *Sylvania Electric Products Inc.* has named **ALFRED L. HUFF** product manager, radio and high-fidelity phonographs and **GEORGE P. LYON** product manager, television . . . **HAROLD A. JONES** has been appointed vice-president and eastern manager for *Motorola Communications & Electronics, Inc.*, a wholly owned sales and service subsidiary of *Motorola Inc.* . . . **H. A. POOLE** has been named to the newly created position of manager, advertising and sales promotion, *RCA Service Company* . . . *Symphonic Radio & Electronic Corp.* has appointed **GEORGE F. BARTH** to the position of manager of marketing services . . . *Ford Instrument Co.*, division of *Sperry Rand Corp.*, announces the appointment of **W. V. WARNER** to the newly created position of general sales manager . . . The election of **DR. W. R. G. BAKER** to the board of directors of *Gulton Industries, Inc.* has been announced. He was formerly a vice-president of the *General Electric Company* . . . **ROBERT G. BACH** has resigned as sales and advertising manager of *Fairchild Recording Equipment Corp.* in order to devote his efforts to the newly formed *Bach Sales Co.* . . . **ALLEN B. DU MONT, JR.** has resigned as vice-president of *Du Mont Television and Radio Corp.* . . . **Z. W. PIQUE** has been named director of sales for the *Hughes Products Group of Hughes Aircraft Company*. He was formerly associated with *Texas Instruments Inc.* and is well-known in the semiconductor field . . . **JOHN W. VAN ALLEN**, general counsel emeritus of the Electronic Industries Association, died recently at 81.

* * *

S. EDWIN PILLER has received an award from the Chief Signal Officer of the United States Army Signal Corps. He is a *National Broadcasting Company* radio engineer who volunteers his spare time as Director of the First Army MARS Technical Network.

Mr. Piller, an active amateur radio operator for more than twenty-one years, conceived the idea of a single-sideband technical network whose prime mission is: the dissemination of technical knowledge by radio communication.

The award was an engraved plaque which read in part: ". . . . for exceptional personal contribution to the Military Affiliate Radio System in the planning, organization, and conduct of the First United States Army MARS Single-Sideband Technical Net . . ."

* * *

J. A. MILLING, *Howard W. Sams & Co., Inc.*, has been re-appointed chairman of the Distributor Relations Committee of the Electronic Industries Association. Norman A. Triplett, of *Triplett Electrical Instrument Co.*, was re-appointed co-chairman.

In addition, the following were named committee members: E. P. Atcherley, *Sylvania Electric Products Inc.*; H. F. Bersche, *RCA*; Fran J. Chamberlain, *Clarostat Manufacturing Co.*; Ernest Clover, *Triad Transformer*

Corp.; R. D. Ferree, *International Resistance Co.;* Charles Golenpaul, *Aerovox Corp.;* John H. Hauser, *CBS-Hytron;* A. N. Haas, *Bud Radio, Inc.;* E. T. Herbig, Jr., *E. F. Johnson Co.;* J. D. Hughes, *Littelfuse, Inc.;* Harry Kalker, *Sprague Products Co.;* Roy S. Laird, *Ohmite Manufacturing Co.;* Wilfred L. Larson, *Switchcraft, Inc.;* J. H. Morin, *Howard W. Sams & Co., Inc.;* R. E. Svoboda, *Amphenol Electronics Corp.;* Earl Templeton, *P. R. Mallory & Co., Inc.;* John T. Thompson, *Raytheon Manufacturing Co.;* and Bruce E. Vinkemulder, *Centralab.* -30-

ARMY MARS TECHNICAL BROADCASTS

HERE is the November schedule for the First Army MARS SSB Technical Net whose purpose is the dissemination of technical knowledge by radio communication.

Transmissions are on Wednesday evenings, 9 P.M. (N. Y. Time whether EDT or EST) on 4030 kc. upper sideband.

Nov. 5—"Application of Transistors in SSB Equipment" by Tom Stewart, Engineering Manager, The Hallicrafters Co.

Nov. 12—"Ionospheric Storms and Their Effect on Radio Communications" by Luther C. Kelley, Project Engineer, U. S. Army Signal Radio Propagation Agency.

Nov. 19—"The Engine Scope" by Gene Ecklund, Manager Automotive Equipment Sales, A. B. DuMont Labs.

Nov. 26 — "Compatible Single-Sideband" by Leonard Kahn, President, Kahn Research Labs. -30-

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				3	4	5
						12
						19
						26

CALENDAR of EVENTS

NOVEMBER 16-21

Conference on Scientific Information. Sponsored by AFOSR/Directorate of Research Communication, NAS, NSF, and American Documentation Institute. Mayflower Hotel, Washington.

NOVEMBER 17-18

Sixth Annual Convention of Society of Technical Writers and Editors. Shoreham Hotel, Washington. Write Society's headquarters at 11 Riverside Drive, New York 23, for further information.

NOVEMBER 19-20

Northeast Electronics Research & Engineering Meetings. Sponsored by Boston, Connecticut, and Western Massachusetts Sections of IRE. Mechanics Hall, Boston. J. J. Faran, General Radio Co., West Concord, Mass., program chairman.

NOVEMBER 20-22

Fifty-sixth Meeting of Acoustical Society of America. Congress Hotel, Chicago. Further information from AES, 335 E. 45th St., New York 17.

"Musts" for Growth

(*Continued from page 62*)

field, have been able to capitalize on it by promoting their TV service facilities and the sale of hi-fi assemblies and components along with FM service, tuners, and sets.

The newest golden opportunity to be laid in the laps of the service industry revolves around the development of stereo discs and stereo replacement cartridges for adapting record players to reproduce these new recordings. Alert dealers will recognize that this new development offers more than just a chance to sell a replacement phono cartridge. Since dual speakers are a must for stereophonic sound reproduction, a "package plan" for modernizing record players which would include the stereo cartridge, a dual-speaker system, cleaning and adjusting the record player, and the cleaning and repair or modification of the set for optimum performance, would be the most efficient plan a dealer could use to take advantage of this opportunity.

Here again the service dealer must know his actual costs of operating when he prices modernization work of this kind. There is often a strong tendency to price work too low in the hope of blocking out imagined competition. The classic example of a lot of volume with no profit was that of the radio service dealer who jumped into TV service work when it came to his town, pricing his work on the basis of his radio service charges. He did $12,000 worth of business during the first six months. When he analyzed his business at the end of this period, to find out what happened to all of the money he had handled, he discovered that it had cost him $13,000 to take in $12,000! He paid out a thousand dollars cold cash, plus six months of his time, to learn the hard facts about getting adequate charges for service time, knowledge, and facilities.

When we read announcements such as the one recently released by the *Bendix Aviation Corporation* which stated that "Auto radar that automatically warns the driver of traffic hazards is now undergoing tests under actual road conditions and a production version of the device is under development," it naturally brings to mind new vistas of opportunity for the independent service industry. But the TV service dealer who has built his business on consumer service would do well to keep his expansion plans focused on the market with which he is familiar.

In order to capitalize on the opportunities that are available to him in his service market, his cost consciousness and knowledge of his income requirements should impel him to readjust his charges to include *all* of his costs of doing business—plus a profit. That is the only road to continued prosperity and growth. —30—

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Model TW-11 — TUBE TESTER . . . Total Price $47.50 — Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$47.50 NET

SUPERIOR'S NEW MODEL TD-55

EMISSION TYPE TUBE TESTER

★ FOR THE EXPERIMENTER or PART-TIME SERVICEMAN, who has delayed purchasing a higher priced Tube Tester.

★ FOR THE PROFESSIONAL SERVICEMAN, who needs an extra Tube Tester for outside calls.

★ FOR THE BUSY TV SERVICE ORGANIZATION, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls.

2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

YOU CAN'T INSERT A TUBE IN WRONG SOCKET
It is impossible to insert the tube in wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

CHECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS
The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

"FREE-POINT" ELEMENT SWITCHING SYSTEM
The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap."

ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATION
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Model TD-55 — TUBE TESTER . . . Total Price $26.95 — Terms: $6.95 after 10 day trial, then $5.00 per month for 4 months.

The Model TD-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

See page 103 for complete details

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Model 77 — VACUUM TUBE VOLTMETER... Total Price $42.50 — Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months.

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

- Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 1006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

SPECIFICATIONS

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)** — 0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only **$42.50 NET**

SUPERIOR'S NEW MODEL 79

The Most Versatile All-Purpose Multi-Range Tester Ever Designed!

SUPER-METER

WITH NEW 6" FULL-VIEW METER

Model 79 — SUPER-METER . . . Total Price $38.50 — Terms: $8.50 after 10 day trial, then $6.00 per month for 5 months.

A Combination **VOLT-OHM MILLIAMMETER.**
Plus **CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.**
Also Tests **SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES**

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Specifications

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
CAPACITY: 001 to 1 Mfd. 1 to 50 Mfd.
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
DECIBELS: —6 to +18, +14 to +38, +34 to +58.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. **All Germanium Diodes.**
All Silicon Rectifiers. **All Silicon Diodes.**

Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on calls. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads.....Only **$38.50 NET**

SHIPPED ON APPROVAL
NO MONEY WITH ORDER—NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

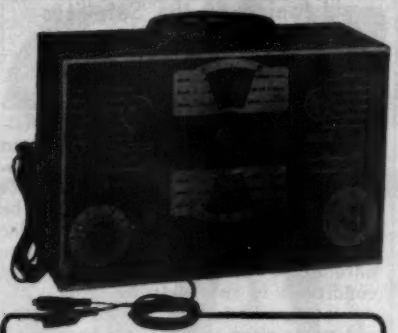
See following page for complete details

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL TV-50A

GENOMETER

7 Signal Generators in One!



√ R.F. Signal Generator for A.M.
√ R.F. Signal Generator for F.M.
√ Audio Frequency Generator
√ Bar Generator
√ Cross Hatch Generator
√ Color Dot Pattern Generator
√ Marker Generator

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

Model TV-50A GENOMETER . . . Total Price $47.50 — Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months.

Specifications

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 200 cycle to 30,000 cycle peaked wave audio signal.

The Model TV-50A comes complete with shielded leads and operating instructions. Only

$47.50 NET

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horisontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

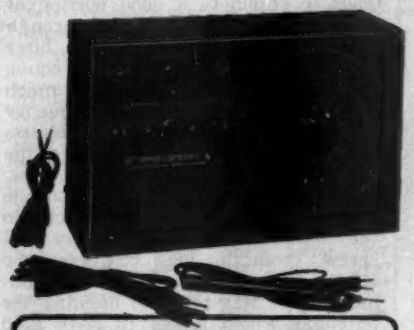
DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 188 Kc., 263.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

SUPERIOR'S NEW MODEL 76

ALL PURPOSE BRIDGE



Model 76 . . . Total Price $26.95 — Terms: $6.95 after 10 day trial, then $5.00 monthly for 4 months.

IT'S A

CONDENSER BRIDGE

with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A

SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to 1000 Microfarads. Will also locate shorts and leakages up to 20 megohms. Measures the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

SIGNAL TRACER SECTION

With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

IT'S A

RESISTANCE BRIDGE

with a range of 100 ohms to 5 megohms

IT'S A

TV ANTENNA TESTER

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna., so why not check the TV antenna first? 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy. Only

$26.95 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C. O. D.

MOSS ELECTRONIC, INC.
Dept. D-538, 3849 Tenth Ave., New York 34, N.Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name .....

Address .....

City ..... Zone ..... State .....

All prices net, F.O.B., N. Y. C.

- ☐ Model TW-11 ..... Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TD-55 ..... Total Price $26.95
  $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model 82 ..... Total Price $36.50
  $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model TV-12 ..... Total Price $72.50
  $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- ☐ Model 77 ..... Total Price $42.50
  $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 79 ..... Total Price $36.50
  $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model TV-50A ..... Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 76 ..... Total Price $26.95
  $6.95 within 10 days. Balance $5.00 monthly for 4 months.

Listening to the Satellites

(*Continued from page 45*)

amplifier, a triode-connected 6AK5 mixer, and a single 6J6 overtone oscillator-multiplier stage. It is certain that a less expensive tube could be substituted for the 417A. A small compromise in signal-to-noise ratio can be allowed because the main type of noise seems to be that which comes in the antenna—even under "cold" antenna conditions in the early morning. The operating voltages on all tubes in the converter were reduced to a bare minimum as a precaution against converter noise. The gain of the converter was such that it was necessary to detune the mixer output coil considerably in order that the "S" meter on the communications receiver would read in the middle ranges. It was found that tight link coupling, using a very short shielded lead, was necessary to eliminate direct pickup of signals by the communications receiver. The local FM broadcast stations have a few splashes near the 108 megacycle channel, but these were minimized by a series-resonant trap in the antenna coupling circuit.

The receiver which is fed by the converter is usually set to as narrow a bandpass as possible. This measure tends to eliminate a good portion of the noise that might still get through the converter. A good audio filter might further eliminate noise. It could, however, sharpen the circuit too much and cut off the high- and low-frequency telemetry modulation and it could also make tuning a hardship because of the Doppler shift.

In recap, please remember that the tracking station described is strictly in the "ham" class. The converter just "grew" from the junk box, even the 417A tube being a reject. The maximum effort was put into building the antennas which seems to have paid off handsomely. It's been fascinating through these weeks and through these miles of tape. —30—

48¢ ea. for any tube

$45.00 Per Hundred

STANDARD LINE ELECTRIC COMPANY

FREE POSTAGE IN U.S.A. & TERRITORIES

FREE TUBE BRIGHTENER ON ORDERS OF $10.00 OR MORE

ANNOUNCING OUR NEW PRICE SCHEDULE

Effective July 25, 1958 all tubes (Radio & Television receiving) will be sold and shipped at the fantastic price of only .48c ea. or $45.00 per hundred. Any "on hand" orders at that time will receive credit for future purchases.

THE TUBES ADVERTISED HEREIN ARE NOT NECESSARILY NEW TUBES BUT MAY BE ELECTRICALLY PERFECT FACTORY SECONDS OR USED TUBES AND ARE SO MARKED

All TV & Radio Tubes are tested by our supplier under actual conditions in Radio & TV chassis or in Hickock Tube Testers Model 533A.

And, of course, the famous Standard Line guarantee remains in effect: All tubes guaranteed to be replaced free if they fail to function efficiently within one year's time. (defective tubes must be returned intact, postage paid. Refunds will be cheerfully made within five (5) days if not completely satisfied.)

0B2	3AL5	5V6GT	6BE6	6S4	7F7	12Q7	32L7GT
0Z4	3AU6	5W4GT	6BF5	6S8GT	7F8	12SA7	35/51
1A5GT	3AV6	5X4G	6BG6G	6SA7	7G7	12SG7	35A5
1A7GT	3BA6	5X8	6BH6	6SB7Y	7H7	12SJ7	35B5
1B3GT	3BC5	5Y3GT	6BH8	6SC7	7J7	12SK7	35C5
1C3GT	3BE6	5Y4G	6BJ6	6SF5	7K7	12SN7GT	35L6GT
1C6	3BN6	5Z3	6BK5	6SF7GT	7L7	12SQ7	35W4
1C7	3BU8	5Z4	6BK7	6SH7	7N7	12SR7	35Y4
1H4G	3BY6	6A8	6BL7GT	6SJ7	7Q7	12V6GT	35Z4GT
1H5GT	3BZ6	6AB4	6BN6	6SK7	7R7	12W6GT	35Z5GT
1L6	3C2	6AC7	6BQ6GT	6SL7GT	7S7	12X4	#37
1LA4	3CB6	6AF4	6BQ7	6SN7GT	7V7	12Z3	#39/44
1LA6	3CF6	6AG5	6BR8	6SQ7	7W7	14A7	#41
1LB4	3CS6	6AG7	6BS8	6SR7	7X6	14AF7	#42
1LC5	3DT6	6AH4GT	6BY5G	6T4	7X7	14B6	#43
1LC6	3Q4	6AH6	6BZ6	6T8	7Y4	14F7	#45
1LH4	3Q5GT	6AK5	6BZ7	6U4GT	7Z4	14F8	#47
1LN5	3S4	6AK6	6C4	6U5	8AW8	14H7	50A5
1N5GT	3V4	6AL5	6C5	6U8	12A8	14N7	50B5
1P5GT	4BC8	6AL7GT	6C8S	6V3	12AB5	14Q7	50C5
1Q5GT	4BQ7A	6AM8	6C86	6V6GT	12AQ5	14S7	50C6G
1R5	4BS8	6AN8	6CD6G	6W4GT	12AT6	17AX4GT	50L6GT
1S5	4BU8	6AQ5	6CF6	6W6GT	12AT7	17DQ6	50Y6
1T4	4BZ7	6AQ6	6CG7	6X4	12AU6	19AU4	50Y7
1T5GT	4CB6	6AQ7GT	6CG8	6X5GT	12AU7	19BG6G	#57
1U4	5AM8	6AR5	6CH8	6X8	12AV6	19C8	#58
1U5	5AN8	6AS5	6CL6	6Y6G	12AV7	19J6	#80
1V	5AQ5	6AS8	6CM6	7A4	12AX4GT	19T8	#81
1V2	5AS8	6AT6	6CM7	7A5	12AX7	19X8	117L7GT
1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AV8	6AU5GT	6CU6	7A7	12B4	25AV5GT	117P7GT
2A5	5AW4	6AU6	6DQ6	7A8	12BA6	25AX4GT	117Z3
2A7	5AZ4	6AU8	6DQ6	7B4	12BE6	25BK5	117Z4GT
2AF4A	5BK7	6AV5GT	6DT6	7B5	12BF6	25BQ6	117Z6GT
2B7	5BR8	6AV6	6E5	7B6	12BH7	25CD6G	807
2BN4	5BQ7	6AW8	6H6	7B7	12BK5	25CU6	9002
2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25L6GT	9003
2E5	5CG8	6AX5GT	6J5	7C4	12BR7	25W4GT	9006
2X2A	5J6	6AZ8	6J6	7C5	12CA5	25Z5	
3A2	5T8	6BA6	6K6GT	7C6	12CU6	25Z6	
3A3	5U8	6BC5	6K7	7C7	12DQ6	#27	
3A4	5U4G	6BC8	6L6	7E6	12J5	#30	
3A5	5V4G	6BD6	6L7	7E7	12L6GT	#31	

ALL RECEIVING TUBES SENT POSTAGE PAID.

Please send 25c handling for orders under $5.00 Send 25% deposit on C.O.D. orders and please send approximate postage on Canadian and foreign orders.

Above is only a partial list — order any type at the same price or send for free tube list and order blank. We have over 5,000 tube types on hand or at easy access, including special purpose, industrial and transmitting tubes which are slightly higher.

ALL TUBES GUARANTEED ONE FULL YEAR...

NOTE: When ordering receiving tubes be sure to enclose 48c for each tube or $45.00 per hundred.

Thousands of TRADE-IN TVs

Please Specify Console or Table Model When Ordering
Reconditioned By Factory Trained Technicians! Guaranteed To Be In Working Condition When You Receive Them!

10"	$25.00	19"	$56.00
12"	$30.00	20"	$63.00
14"	$35.00	21"	$70.00
16"	$42.00	24" (when available)	$95.00
17"	$49.00	27"	$129.00

Get yourself a second set or buy some for re-sale!

All TVs sent motor freight or Railway Express F.O.B. our warehouse. Sorry, no A.P.O. shipments.
FREE INDOOR ANTENNA with each TV Purchase

below is our new price schedule of pix tubes. These famous make tubes contain all new parts with the exception of the glass bulb which does not wear out.

Any 10" Tube	$ 9.95	Any 16" Tube	15.95
Any 12" Tube	10.95	Any 17" Tube	18.29
Any 14" Tube	13.95	Any 19" Tube	20.29
		Any 21" Tube	24.29

Prices On Larger Tubes On Request

Remember
Only 48¢ ea.
$45 Per Hundred
ANY TYPE
ANY QUANTITY

Remember — NO Dud Required.
All tubes guaranteed one year.
Picture Tubes shipped F.O.B. Harrison, N. J.

STANDARD LINE ELECTRIC COMPANY

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Adding a VU Meter to the "Outboard" Amplifier

By EARL E. SNADER

Customer Service
Viking of Minneapolis

By popular request, a refinement for the circuit which originally appeared in our January issue.

A LARGE number of inquiries have been received by the author since his article "Outboard Equalizer-Bias Amplifier for Tape Recording" appeared in the January 1958 issue, asking how a vu meter can be added to the unit in place of the original electron-ray "magic eye" record level indicator.

The schematic diagram of Fig. 1 shows the circuitry for a 6C4 vu meter driver stage that can be built into the "outboard" recording amplifier in place of the original 6E5.

The vu meter driver stage is connected in a cathode-follower configuration. The signal is taken from the recording amplifier at the same point as for the 6E5 in the original circuit. No crystal diode is necessary. A 250,000-ohm linear potentiometer functions as a calibration control. Plate power for the 6C4 is taken from the point marked "F" in the original circuit.

The 6C4 can be mounted on a flange similar to the one provided in the original unit for the 6E5 tube socket. The flange is located about 2¼" from the front of the chassis. In this position it will straddle the back part of filter capacitor mounting and provide the necessary space for the meter calibration control which is mounted on the top of the chassis, between the bias oscillator transformer and the filter capacitor. A 7-pin miniature tube socket is installed in the new flange, with the tube toward the front in the same relative position as the original 6E5. The meter calibration control will be just behind and above this tube socket and should be mounted so its terminal lugs are toward the socket.

Since most vu meters are too large to mount on the small chassis of the "outboard" recording amplifier, a second *RCA* phono jack will be needed for connecting to an external vu meter. This can be installed on the top of the chassis, in front of the filter capacitor and directly above the vu meter driver tube.

Any standard vu meter with an internal impedance of about 3900 ohms can be used.

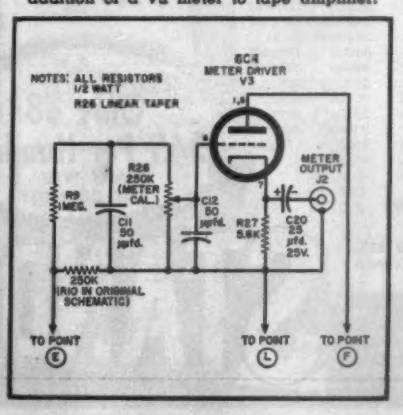
To calibrate the meter, remove the 12AV7 bias oscillator tube and connect a 100-ohm resistor in series with the record head. Turn on the recording amplifier and feed a 1000-cycle signal into the normal recording input jack. Adjust the record level control until a reading of .008 volt a.c. r.m.s. is obtained with a high-impedance vacuum-tube a.c. voltmeter connected across the 100-ohm resistor in series with the record head. Adjust the calibration control so a "0" reading is obtained on the vu meter under these conditions (this will correspond to a "100" reading on a "B" scale vu meter). This represents a recording current of .08 ma. at 1000 cycles at a recording level about 8 or 10 db below saturation with a record head having an impedance of 2000 ohms at 1000 cycles.

The one special precaution that is necessary in adding the vu meter to the "outboard" recording amplifier is to provide as much isolation, physically as well as electrically, between the vu meter driver and the bias oscillator. Otherwise part of the bias signal may get into the vu meter driver and cause a slight deflection of the vu meter even when no program material is present at the recording input jack of the unit.

Since more and more recording fans are demanding "professional" feature in their home machines, we are glad to comply with requests for details on how a vu meter can be incorporated.

Although this change was worked out for the equalizer-bias amplifier the author described in the January issue, other machines with similar circuitry could be altered for a meter. —30—

Fig. 1. Simple circuit changes permit the addition of a vu meter to tape amplifier.



X-Rays from TV Sets

(*Continued from page 59*)

set—being careful to mount it away from the high heat of any of the components and being sure the paper clip is attached firmly so that it won't fall across the tube pins—and leave it for two or three weeks. Alternately, you can tape the film to the face of the picture tube for about a month. After the required time has elapsed, develop the film or talk your dentist into developing it for you. If a shadow of the paper clip appears on the film—you might then have cause to worry about x-ray radiation.

The result of the author's experiments boils down to this one fact—protection from the radiation "hazard" of television sets amounts to the selfsame procedures involved in avoiding electric shock. When repairing a TV receiver and replacing the chassis in its cabinet, be sure to restore all of the original hardware as insurance against radiation for both you and your customer. —30—

STARVED AMPLIFIER

BY A. V. J. MARTIN

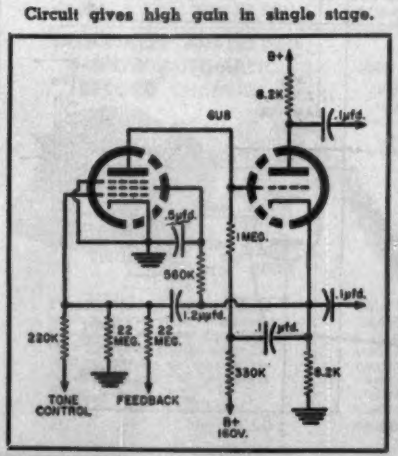
THE starved amplifier circuit, where a pentode is fed very low plate and screen voltages, is interesting because it can provide a very high gain in a single stage.

A 6U8 triode-pentode is used. The input stage is the pentode. The grid circuit contains a tone control and a feedback circuit (not shown). The plate is fed from "B+" of 160 volts through a large value resistor and is directly tied to the grid of the triode, used as a split-load driver for an output push-pull of 6AQ5.

The screen-grid of the input pentode is fed from the cathode voltage of the triode through a decoupling circuit. The triode, acting partially as a d.c. cathode follower, has a stabilizing effect on the input tube.

At high frequencies, an extra amount of stabilization is provided by a small capacitor between the cathode of the triode and the input grid. This technique is being used in a moderately priced audio amplifier of French manufacture. —30—

Circuit gives high gain in single stage.



Test Bench PUZZLER: No. 3

By **ART MARGOLIS**

Here you see the boosted "B+" and there you don't. Where did it go in winding through the windings?

FIRST ORDER of business when TV technicians get together is a bull session in which tough or unusual cases get traded. This one, although not one of the toughest to come up, is interesting because there is an unusual element involved.

The face of the picture tube appeared as shown in Fig. 1. Evidently there was no vertical sweep on this *Motorola* TS236. However, the horizontal line showed good brightness, and sound output was normal. Naturally the 12BH7, acting as a combined vertical oscillator and output tube, was checked. There was nothing wrong with it. A reading at the output plate of this stage (point 1, Fig. 2) provided an immediate clue: while 470 volts is called for, actual voltage was close to zero.

Boosted "B+" for this point originates at the damper cathode (point 2). This potential may then be traced through a winding in the high-voltage transformer, into the vertical-deflection coils, and through the vertical-output transformer before it reaches the 12BH7. At the damper cathode, however, an acceptable 480 volts was noted. This meant that boosted "B+" was being lost somewhere in the chain already mentioned.

Approach the problem this way: the wiring of the yoke and the two output transformers is extremely confusing, so you are going to try to save yourself unnecessary trouble by figuring out what had happened in which component or components. To avoid extra work, which component would you try first and which last?

Don't feel bad if your answer doesn't match the one on page 141. *Logic aside, this one will take a little luck or inspiration.* —30—

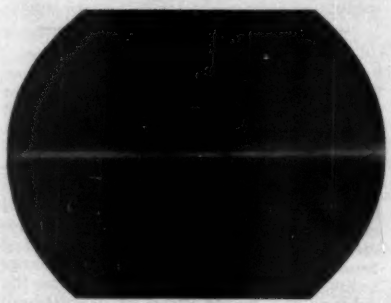


Fig. 1. Vertical deflection was lost.

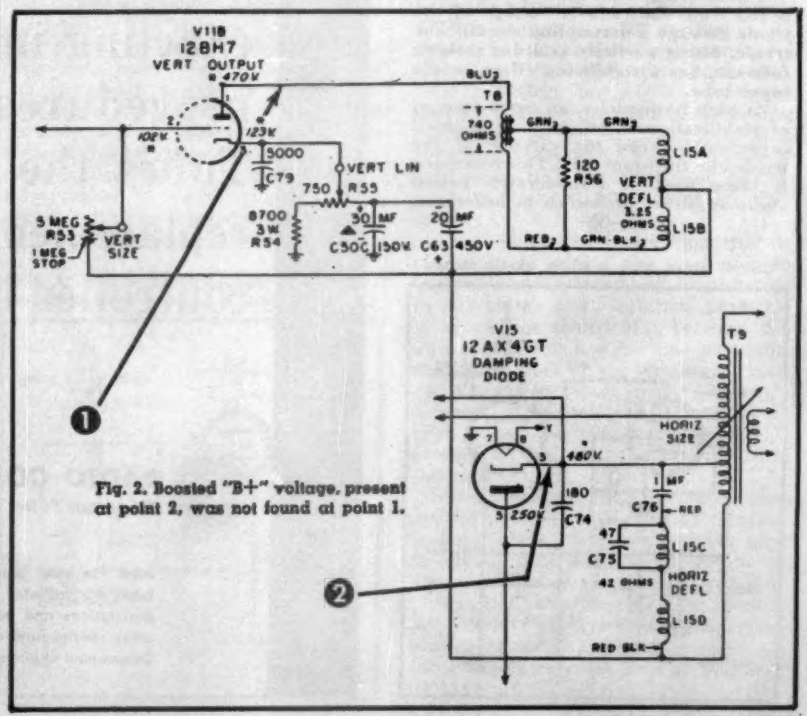


Fig. 2. Boosted "B+" voltage, present at point 2, was not found at point 1.

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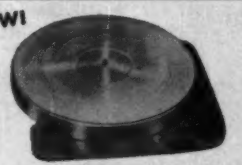

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FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8-kc bandwidth and frequency response 20-5000 cps ± 3 db.

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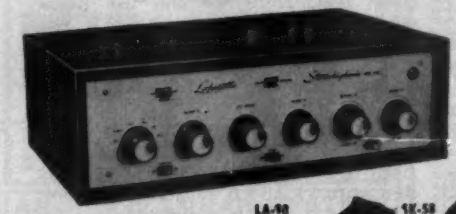

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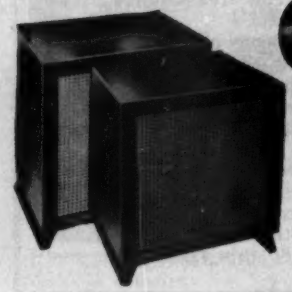

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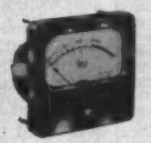

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Indoor P.A. Systems

(*Continued from page 56*)

Each section of the audience area has to be dealt with separately. First there is the main floor area, with plenty of room upwards. This is easy to fill. Then there may be spaces between levels: on the ground floor under the balcony and then successive balcony areas. These are narrower spaces, at least toward the front, although they sometimes open out farther back. This means that not enough sound will get through the frontal opening to fill the entire area. Extra speakers are needed to fill these "dead" spots in the auditorium.

Power Requirements

The kind of speaker and the power it needs will depend on the volume of space to be filled and how reverberant it is. The main floor, for example, may have carpeted floor and upholstered seats, with acoustically "dead" walls, while the balcony levels may have bare wooden seats and untreated walls. More power will be needed on the main floor to provide the same volume level as that available in the balcony. Too much power in the balcony could upset the whole installation.

Table 1 is included to help the p.a. man determine over-all power requirements. The technique can be demonstrated, using the installation diagrammed in Fig. 4 as an example. First work out the volumes to be fed by each group of speakers.

The front area is, say, 40 feet from the stage to the front of the balcony overhang, 60 feet wide, and we can estimate the "ceiling" height as 40 feet, although the true ceiling is actually almost 80 feet above the main floor. Working in ten-foot units each way, $4 \times 6 \times 4 = 96{,}000$ or, roughly, 100,000 cubic feet. Here we can use high-efficiency units, because space is not restricted and the absorbency is "normal." Thus, this area requires about 10 watts, at .1 watt per thousand cubic feet.

The rear of the main floor is an average of 30 feet high, 35 feet from front-to-back, and 60 feet wide. This figures to $3 \times 3.5 \times 6 = 63{,}000$ cubic feet. As space is a little restricted, smaller units of the medium-efficiency type must be used. This area requires $.3 \times 63$ or about 20 watts.

The lower balcony averages about 20 feet high with the other dimensions the same. This is $2 \times 3.5 \times 6 = 42{,}000$ cubic feet, requiring about $.3 \times 42$ or 12.6 watts—say, 15 watts to allow a margin.

The top balcony area is non-absorbent. Medium-efficiency units can still be used. Average height is again about 20 feet with the same dimensions the other ways. So this 42,000 cubic feet needs about $.1 \times 42$ or 4.2—say—5 watts for adequate coverage.

Now we merely total the powers to find the amplifier requirement: $10 + 20 + 15 + 5 = 50$ watts. This is a fairly complicated installation. Smaller ones will be correspondingly easier to assess. In this installation, the front loudspeakers could be of the fairly large enclosure type, using high-efficiency, unitized loudspeaker units. The loudspeakers at the rear of the main floor can be either smaller cabinet types or the bowl type which is very useful in this kind of location. Both these fall into the medium-efficiency group. If you have to use really small cabinet types—say, an 8" unit in a box 12" x 12" x 8" because of space limitations, this will be quite low efficiency.

Another important question is how

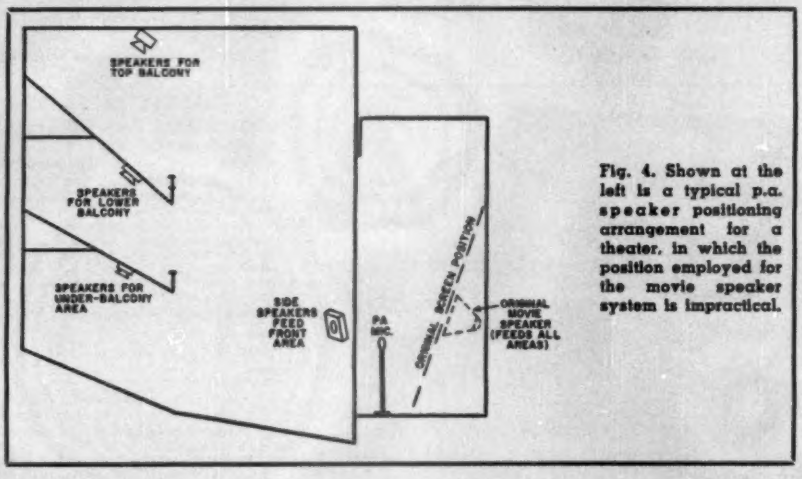

Fig. 4. Shown at the left is a typical p.a. speaker positioning arrangement for a theater, in which the position employed for the movie speaker system is impractical.

SPEAKER EFFICIENCY	KIND OF SURFACE HARD	MEDIUM	ABSORBENT
Low	.3	1	3
Medium	.1	.3	1
High	.03	.1	.3

Table 1. Amplifier power (in watts) per 1000 cubic feet of volume.

110V AC to 110V DC RECTIFIER & CHARGER

Manufactured by Hallicrafters

INPUT: 95 to 125V 50-60 cycle AC, or 190 to 250V 50-60 cycle AC. **OUTPUT:** 115V DC up to 400 Ma.; 115V AC up to 4.35 Amps. This unit is ideal for Garages, Gas Stations, Auto Supply Stores, to maintain a series of batteries on display. Also fine for Research Labs, Engineers, Manufacturers, operate DC Teletype Equipment, etc. A TERRIFIC BUY AT OUR SMASHING LOW PRICES! Like New..... **$11.95**
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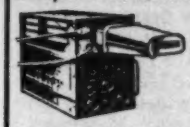

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FINE QUALITY NAVIGATIONAL EQUIPMENT

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Excellent. Used $10.95

TS-100/AP OSCILLOSCOPE (worth $750) OUR LOW PRICE $33.33

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DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only..... **$2.95**

DYNAMIC HANDMIKE, aircraft, made by Telephonics Corp. Press-to-talk switch. BRAND NEW.. **$4.95**

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special..... **$3.95**

Hi-Fi DYNAMIC HEADSET with Cushions
Freq. Range: 40-14000 CPS. No Distortion. BRAND NEW **$7.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike....	$4.95	$7.45
T-30	Carbon Throat Mike....	.39	.79
T-45	Army and Navy Lip Mike		1.33
T-24	Carbon Mike		5.95
TS-9	Handset		3.85
RS-38	Navy Type	2.79	4.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance.....	$2.25	$4.75
HS-33	Low Impedance	2.79	4.75
HS-30	Low Imp. (featherwt.).	1.25	1.99
H-16/U	High Imp. (2 units)...	3.75	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS. BRAND NEW, PER PAIR.... **$3.45**
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Earphone Cushions for above—pair..... .50

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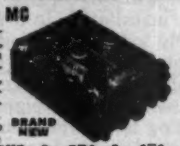
BC-645 XMTR RECEIVER
15 Tubes 435 To 500 MC



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Complete set of 10 Plugs for BC-645 ..... **$5.50**
CONTROL BOX for above..... $2.25
SHOCK MOUNT for above..... 1.25
CONVERSION BOOKLET. Instructions for most useful surplus rigs..... **$2.50**

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BC-348 SUPERHET RECEIVER. Locally controlled 8-tube 6-band receiver for aircraft, communications type, for voice, tone and CW. 200 to 500 Kc and 1.5 to 18 Mc. For operation on 24 V DC with self-contained dynamotor. Complete with tubes. **$88.88**
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Exc. used .....

AR/ARN-6 RADIO COMPASS EQUIPMENT. Frequency 100 to 1750 Kc in 4 bands. 24 V DC operation. **$119.50**
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BRAND NEW $169.50

BC-733 VHF 10-TUBE AIRCRAFT RECEIVER. 6-channel xtal control. Freq. 108.3 to 110.3 Mc. Dual filter range. Easily converted for tracking Sputniks! **$9.95**
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BRAND NEW $12.95
Dynamotor for above 12/24 V.—Now $5.95

AN/APR-4 RECEIVER only. 38 to 4000 Mc in 5 tuning unit ranges. High precision laboratory instrument used to monitor or indicate frequency of any signals within its range. Includes wide and narrow band IF strip selected from panel. Outputs provided for attachments to pulse analyzer, panadapter, etc. Input 115 V 60 cy. BRAND NEW **$69.50**
Tuning Units for above—each..... $39.50

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AN/ARC-1 Airborne radiophone ground to plane Rcvr-Xmitter. 10-channel xtal controlled, easily converted to 20 or 50 channel, VHF 100 to 156 Mc AM. Complete with tubes, mtg rack, dynamotor. OUR LOW PRICE **$89.50**
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BC-455	Receiver 6-9 Mc.....	10.95	13.50
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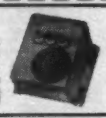

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DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24
PE-186	28V 11A	400V .400A		6.95
2889	14V 2.4A	250V .060A	....	5.95

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many units to use to feed an area. The easiest way to answer this is: use as many as needed to maintain uniform coverage. Of course, convenient mounting points can help to determine whether to use, say, four or five units. If, for instance, you have to make a p.a. installation in a restaurant with a fairly low ceiling, you will need a relatively large number of low-level units —almost one for every table. With a higher ceiling height (assuming the ceiling is the most convenient place to mount the speakers) a smaller number can be used to cover the same area but with each speaker operated at a proportionately higher output level from the amplifier.

Power Distribution

This brings us to the question of power distribution. In the simple two-speaker installation, the two units are connected in parallel across the amplifier output tap whose impedance rating is half that of each unit. In more complicated installations we need some means of adjusting the power delivered to each unit. The simplest way to do this is to use an amplifier with a 70.7-volt output.

While the 70.7-volt line is a convenient way of feeding a number of speakers to avoid unnecessary losses and is an easy way to figure power distribution, the basic problem is in terms of impedance matching. It isn't necessary to calculate the impedance, provided we use the constant-voltage-line calculations correctly.

The important thing is that the total *nominal* rating of the loudspeakers (with their 70.7-volt line transformers) should not exceed the power rating of the amplifier feeding them. For example, if two 10-watt speakers and four 5-watt ones are connected to the 70.7-volt tap of a 25-watt amplifier there will be a serious mismatch and the available power will be less than 25 watts. Two 5-watt speakers plus four 2-watt units would give more actual power in this system since they total 18 watts. This means the amplifier will deliver a little more than 18 watts undistorted.

What do you do if you are using a 60-watt amplifier and need to feed two speakers at about 5 watts each? Here there is some choice. To get the best amplifier performance, two 70.7-volt speakers with a rating of 30 watts could be used to match the amplifier. The gain would then be turned down so the amplifier output was about 10 watts.

This method might give a higher hum or hiss level than could be tolerated, in which case the best plan would be to use two 5-watt speakers and a dummy load to absorb the remaining power—50 watts at 70 volts. This requires a 100-ohm, 50-watt resistor. This method "throws away" much of the available power and may not have enough "headroom"—so a compromise may be better. Say we use two 10-watt speakers and then put only 40 watts in the dummy load. This will require a 125-ohm, 40-watt resistor, which is a little easier—four 500-ohm, 10-watt resistors in parallel will do the job.

It has been demonstrated that a public-address amplifier needs flexible output connections. It should have the regular 4-, 8-, and 16-ohm taps as well as a 70.7-volt output for maximum usefulness.

It should be noted that a loudspeaker's power rating and its 70.7-volt rating, with transformer, are two quite different things. The first states the maximum power the unit will handle. The second indicates the relative power it will take from a 70.7-volt line, due to the matching provided in its line transformer.

For example, if a 25-watt speaker uses a 10-watt matching for a 70.7-volt line, it will get 10 watts if the amplifier is correctly matched. But, if it is a 10-watt loudspeaker with 25-watt line matching, it may receive as much as 25 watts if correctly matched. In this case you must be sure that the full output is not delivered otherwise the speaker will very likely be burned out.

Wiring

One precaution is especially necessary when using 70.7-volt lines: keep the speaker leads well away from the mike lines. Failure to observe this rule may result in amplifier instability. As 70.7-volt line wiring is unbalanced (one side is grounded in most 70.7-volt amplifier outputs), it is also best to use a twisted cable rather than flat twin-lead.

Mike cables should be selected on the basis of the microphone picked for the job. High-impedance mikes must use shielded wire, preferably of the low-loss, low-capacitance type. Low-impedance mikes (50 ohms or lower) may use shielded twin, but often plain twisted twin is satisfactory, especially where runs are short. Line-impedance mike cables should be balanced, or ungrounded, using shielded twin cables, with the shielding grounded.

Phasing

Phasing is important for best results. If only one microphone is used, or the microphones are widely separated, microphone phasing may be disregarded. If you use mikes close together and wrongly phased, reproduction will be "gutless" and you will soon hear about it. In a loudspeaker system, however, incorrect phasing can result in areas that are poorly served. Try reversing connections to the loudspeaker feeding the area where confusion of sound is the greatest.

Good public address, indoors as well as out, should be an unobtrusive public servant. The audience wants to hear the program, not the p.a. They won't hear the program without the p.a. but if they are aware of this fact, it is not a good p.a. installation. As in any public service the best justification for better recompense for the installation is a job well done! —30—

Slide-Projector Fade Control

By **FRED J. LINGEL**

PROJECTING slides for an illustrated lecture can be done with a real flair if a fade control is used in conjunction with a duplicate projector.

The unit to be described was built up for a rush job where time to locate a commercial unit was lacking. To allow for some overload capacity, a 10 ampere General Radio 117-volt variable transformer or "Variac" was used. This was wired as shown in Fig. 1. One projector was then connected between the center point and one side of the "Variac" winding while the second projector was connected from the same center point to the other side of the "Variac" winding. Each set of connections was brought out to a separate socket on the housing. This resulted in a simple fade control unit in a single, compact case, without affecting the regular operation of the "Variac."

To finish off the unit, a handle was mounted to the rim of the large round knob normally supplied with the "Variac." The weight of the unit and the use of the knob permitted the control to be rotated easily with one hand and eliminated the need for fastening it down or holding it.

A brass roundhead screw was threaded to the case at each end of the throw to limit the angle of travel. These stops still allowed between 10 and 20 volts across the projector lamps in the "dark" position but the light at this voltage was low enough to go unnoticed on the screen.

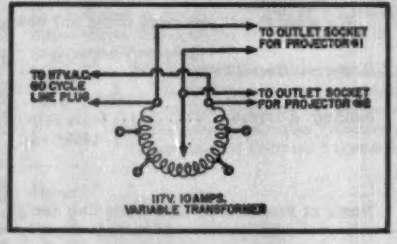
In operation, each projector is focused on the screen so that successive slides will appear to blend one into the other as the fade control is moved. This will occur since one lamp will dim automatically as the other is brought to full brilliance.

Some freedom from refocusing may also result from the use of the fade control since the "waiting" slide is in the hot housing of its projector prior to its being illuminated. In this way the slide will be warmed near its final displaced or "popped out" form when the light is turned on.

While the author's unit was built around General Radio's "Variac," other variable transformers of suitable rating, such as those manufactured by Superior Electric, Acme Transformer Co., and others could be used.

If you are often called to "run the machine" for professional or amateur illustrated talks, it will pay you to build this unit since it adds so much to the smoothness of such performances. —30—

Fig. 1. Wiring diagram for fade control which permits operation of two projectors.



ALAMEDA COUNTY TELEVISION & RADIO ASSOCIATION

SENIORITY is no measure of effectiveness. The Alameda County Television & Radio Association, 6609 Chabot Rd., Oakland 18, Calif., has only been around about five years, but it boasts 43 members and a creditable record of accomplishment.

Organized in 1953, ACTRA is incorporated as a non-profit group. Officers include Sam D. Ditto, president; Lee LePeilbet and Frank Lozano, 1st and 2nd vice-presidents; Philip M. Fisher, executive secretary; Fred W. Rock, corporation secretary; and Mel Dumolt, treasurer. Regular meetings are on the first Tuesday of every month at the "Driftwood" in Alameda; directors meet the last Tuesday of each month at member shops. Elections fall in November.

The "ACTRA Flash Bulletin," edited by Philip M. Fisher, is officially a monthly, but actually appears more frequently. In an attempt to serve the entire local industry, without regard to membership, "extras" are brought out whenever the occasion demands.

When ACTRA was born, the Better Business Bureau of Metropolitan Oakland lent a hand in drawing up the Code of Ethics. On election, the incumbent ACTRA president automatically becomes a director on the board of the local BBB. This coordination, characterizing an association keenly aware of a public outside of itself, is reflected in many other ways.

For example, in its fight to "clean up the few chiselers in our industry" who are giving "all of us a bad reputation," ACTRA has worked with police, DA, and the BBB in convicting unethical operators. Its cooperation in this direction has not only relieved the industry from the usual stigma that brands all technicians when such incidents are publicized, but has enhanced the organization's prestige.

Opportunities for favorable publicity are not overlooked. Even personal incidents involving members, if they are interesting, are called to the attention of the local press. Originally called "Television & Radio Association of Alameda County," the group reversed its name to obtain better position in the classified directory, where it lists members. The switch worked. This advertising carries the ACTRA emblem and slogan: "Customer Confidence through Dealer Integrity."

The Alameda group consistently tries to make the public understand that a good technician is worth his price and that shopping around for the lowest house-call fee is *not* the way to get the best service, or even the cheapest, in the long run. Largely due to its efforts, major local papers no longer run "bait" advertising, stating that they have stopped "in the public interest . . . and to maintain public confidence."

The Alameda group feels that there must be increasing emphasis on developing a business sense in addition to technical competence. To maintain integrity, it screens members before admission and polices them afterward. One was dropped a few months ago when, after repeated warnings, he continued to violate the Code of Ethics.

A member of the California State Electronics Association, ACTRA also works with other service groups in the San Francisco Bay Area. In conjunction with these, it circulates a local Consumers' Pricing List to the industry, intended as a reference guide rather than a mandatory schedule.

Divided on the licensing question, ACTRA nevertheless does keep one eye on unethical operators, with the other on existing business regulations. It has also worked out a wage scale, in an amicable way, with an interested union. -30-

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An Improved Probe

(*Continued from page 63*)

into the tubular body of the probe. The perforated Bakelite, when trimmed to the correct size for the probe shell, will fit with no wobble or play. Any components mounted on the Bakelite strip will be well spaced away from the shell wall, and the possibility of arcing or excessive capacity to ground will thus be eliminated. The probe body or shell is a 5- or 6-inch length of aluminum tubing from an old antenna mast or electrical fixture.

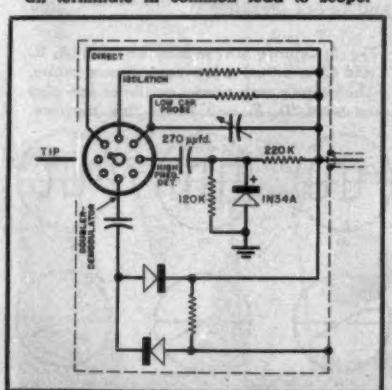
The plug in the end of the probe can be an end sawed off a wooden dowel or a plastic or rubber cork. In order to shield the internal components of the probe properly, it is necessary to run a short length of uninsulated wire from the common or ground side of the internal probe circuitry between the end plug and the shell. The ground lead with alligator clip connects to this same point. Inserting the plug tightly will both ground and shield the unit effectively. The end of the tube can be crimped slightly, if necessary.

A tight fit of the octal socket at the other end of the probe shell isn't important. The socket itself may be an *Amphenol* RS type or one of those with a molded or clamped-on mounting plate. Removal of the plate and a little judicious filing may be needed for the proper fit.

A coat of black paint on the probe will allow the function of each input to be marked on the shell itself, as shown in Fig. 3. Either electronic decals can be used for that "professional look" or the marking can be scratched on with an awl immediately adjacent to the appropriate socket pin number. A nail or a length of stiff copper wire is used on the probe tip. If desired, the tip can be insulated along its length with spaghetti.

The pigtail leads of the components are interwoven through the perforated board in standard wiring technique for this sort of material. The components

Fig. 4. Suggested circuits for various probe functions. Values not shown may vary. Each circuit connects to separate point on octal socket at one end, but all terminate in common lead to scope.



or probe functions that will be built in will, of course, depend upon your particular needs. The basic circuits that can be incorporated are illustrated and discussed in "Probes" (*Gernsback Library* #54) and "How to Use Test Probes" (*Rider* Publication #165). Some popular configurations are suggested in Fig. 4.

The low-capacity probe function deserves some discussion. The resistor shunting the trimmer capacitor should have a value approximately nine times the input impedance of the scope. Many recent model scopes have a 3.3-megohm input which dictates the use of a 30-megohm resistor. A 1-megohm scope input calls for a 9-megohm resistor to maintain the attenuation factor at the convenient figure of 10.

Adjustment of the low-capacity trimmer is best done with the aid of a square-wave generator. Set the generator to about 15 kc. and feed the signal into the scope *via* the low-capacity function of the probe. The scope will probably display a waveform resembling Fig. 5A or B. Adjust the trimmer until the square-wave is reproduced properly. If the overpeaked condition of Fig. 5B is obtained and cannot be flattened out, try reducing the minimum value of the compensating trimmer. If high-frequency rolloff, as shown in Fig. 5A, is present and unadjustable, more trimmer capacitance is needed. A good starting value is a trimmer with a range of about 3-30 $\mu\mu$fd.

If a square-wave generator is unavailable, the scope's internal sweep oscillator can be used to provide a test signal for adjustment. Connect the probe as usual to the vertical-input terminals and tap off the saw-tooth signal of the scope at the output of the multivibrator tube. The scope sweep frequency should be set at about 1 kc.

A trace as shown in Figs. 5D, E, or F will be observed. Fig. 5F is the desired waveshape and the trimmer should be adjusted for the closest resemblance to it. The comment above pertaining to lack of adjustment applies here also. An upward hooking corresponds to peaking and the capacity of the trimmer should be reduced.

In the cases of the above adjustment where inversion or transposition of the waveform occurs, it indicates a peculiarity of the scope rather than the probe, and is not significant. —30—

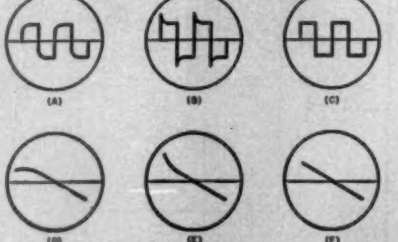


Fig. 5. Square waves may be used (A, B, and C) to adjust a low-capacitance probe. The scope's own sweep oscillator can also be used (D, E, and F) for this purpose.

SOUND ON TAPE

By BERT WHYTE

AS YOU may have noted in my record column this month, I have been spending some time in England this summer and I reported on the rather frenetic stereo disc activity taking place there. One might ask: Where does all this leave the British stereo tape enthusiast? As I pointed out briefly in the record column, tape activity in England was at a very low ebb, with no new tapes having been released for some time. This was an observation I made during the very early part of my trip and I am happy to say that some three weeks later, my opinion has had to be revised.

I think I should also take a little smug satisfaction in that what is happening in England is quite the same thing as I predicted would happen in America, namely that rather than kill stereo tape, a view shared by a good many people, the stereo disc will stimulate stereo tape sales. At the English radio show, held during the latter part of my visit, almost all of the British tape machine manufacturers announced new stereophonic recording and playback units.

In connection with this, there also seems to be a resurgence of interest among the manufacturers of stereophonic tapes with some new releases and more promised for the near future. One might question why the situation in England is analagous to that in the United States. I think I can safely say that the reasons are identical. In other words, many British stereo tape enthusiasts and many British hi-fi enthusiasts who had contemplated a change to stereo disc have heard their first stereophonic discs and concluded that, good as they are, the disc still falls short of the best stereo tapes in quality. Evidently, these groups are as vocal in England as they are in America and no doubt their comments and decisions regarding stereo have been reaching the right manufacturers' ears.

At this point you might well ask why the British stereo tape situation should be of any interest to you. Once again, as in the case of discs, it is a question of repertoire. If the British stereo tape enthusiasts were to have been completely stilled and no further pleas made on behalf of the medium, then we should have had quite a curtailment in the production of British stereo tapes which, of course, would have been ultimately reflected on the American market, and we would have missed many wonderful musical experiences. So, at least in the field of two-channel, 7.5 ips stereo tape, our British cousins are not altogether in a hopeless state. However, as far as our latest innovation, the 4-channel, 3.75 ips stereo

tapes are concerned, this is almost a totally blank picture. Most of the manufacturers have heard about these tapes, but outside of that, nothing is known nor does there seem to be even the faintest glimmer of any plan to produce and market either tapes or the necessary machinery on which to play them.

However, I feel that after some of the British representatives visit the New York Hi-Fi Show, where they will be thoroughly exposed to 3.75 ips, 4-channel tape, the idea may strike them that this development is just the thing for the British market. After all, the British people pay a great deal more for music in all forms than we do and this is especially true in the case of stereophonic tape. Thus the 3.75 ips development with its concomitant lower cost may be just the thing the British have been seeking. Here, again, one must not take the attitude of "Who gives a toot what they want or do in Britain?" but must always take the broader view that if 3.75 ips tape catches on in Britain, we stand to benefit from increased repertoire. Since the deadline for next month's column and the New York Hi-Fi Show more or less coincide, if I am lucky, I will be able to bring you a report on what happened there, in terms of our present 7.5 ips tapes and what progress has been made in the new 3.75 ips tapes. Unfortunately, I must once again confess that due to concentration on the stereo disc and for seasonal reasons, tape releases have been minimal and there is nothing much to report. However, here are a few of better-than-average quality:

GRIEG
PIANO CONCERTO
Richard Farrell, pianist, with Halle Orchestra conducted by George Weldon. Mercury MCS5-27. Price $11.95.

This is the second stereophonic version of the Grieg "Piano Concerto," the other being on a *Victor* tape with Artur Rubenstein. It should be noted from the outset that this tape must more or less stand on the merits of sound for while Richard Farrell affords a conscientious and workmanlike performance, it is in no way the equal of the Rubenstein reading. Farrell has not learned to employ the longer line in his version and lingers overly long on details. It will be difficult to detect a wrong note in this performance, but then there are many technically perfect performances that are totally devoid of any warmth and expression. Farrell gives us occasional moments with the proper emotional values but, for the most part, he is too busy polishing each and every facet.

In matters of sound, however, this is superior to the *Victor* tape by a considerable margin. For one thing, this is of the 3-channel variety which is subsequently dubbed down to two channels with the third channel appearing as a "ghost" image. The *Victor* tape was of the two-channel variety and suffered somewhat from the hole-in-the-middle effect. In the *Victor* tape the piano is recorded at some distance and the re-

sult with the particular reverberation characteristic of the recording hall is rather diffuse and the piano lacks true definition and articulation; in the *Mercury* recording the piano is very big and bright and projected well forward, but in carefully maintained balance with the orchestra. The reverberation period of the Manchester Free Trade Hall, where this was recorded, is rather long but by recording the orchestra and piano quite close up, the engineers have managed to enlist its aid in furnishing us with a very live sound of very clean and distortionless quality. Directionality was good here, with the piano remaining centered as the "ghost" channel and not jumping from left to right or *vice versa*, as is the case with many less well-engineered concertos. Thus it is up to you which weighs more heavily—the very fine sound of this *Mercury* reading or the superior performance of Rubenstein, recorded with a sound of considerably less luster.

WAGNER
DAWN AND SIEGFRIED IDYLL
Detroit Symphony Orchestra conducted by Paul Paray. Mercury MAS5-20. Price $9.95.

As has been noted before, Paray is one of those improbable Frenchmen who can conduct Wagner. His readings may not always be to the liking of a dedicated Wagner purist, but most people find them extremely well wrought and most interesting. With the "Dawn" music and the "Siegfried Idyll" he is particularly effective as, after all, this comes closer to his native Debussy than any other Wagnerian music. Here he paints a very evocative picture and except for tempi which most people would regard as a little too fast, the performance is otherwise a model of phrasing and dynamics.

Mercury has afforded Paray a rich glowing tapestry of sound and, unlike a great deal of Wagner of this type, it is not merely a great amorphous sound. One can distinctly hear all the various choirs and easily perceive instrumental separation. Directionality was not as pronounced here as in some other *Mercury* recordings, but probably this is more a matter of scoring than it is of any technical deficiencies. Throughout, the sound is very clean and luminous with the broad acoustics particularly well suited to this atmospheric work. Paray elicits some particularly fine string and woodwind playing from the great orchestra and, all-in-all, this is a stereo tape which I am sure you will enjoy.

OUT ON A LIMB
Pete Rugolo and his Orchestra. Mercury MVS3-7. Price. $7.95.

This is a tape which I certainly cannot honestly say is for all tastes because, while friend Rugolo can be very entertaining and easily assimilable, in this case he really is "Out on a Limb" musically. In other words, this is Rugolo in one of his "avant garde" moods and the scoring of the music, while

exceedingly clever and well done, shrieks with dissonance and atonalities and I think nearly everybody gets into the act from Hindemuth to Bartok and Stravinsky and back again.

As a stereophonic sound experience, this has some pretty terrific effects with much exploratory plumbing of sonic depths with instruments normally never played in those registers and, on the other side of the coin, some stratospheric screeches which must sorely tax the lips of the poor brass players. Of course, this type of recording is quite artificially done and things like directionality and instrumental separation are very precise. So, if you have a persuasion for the modern, this is for you. —30—

For the Record

(*Continued from page* 8)

proud of the fact that year after year these audited reports reveal that RADIO & TV NEWS has the largest circulation of any technical electronic publication in the world! To you our readers and advertisers, we offer a heartfelt "Thank You."

It is well to keep in mind that the more advertising we carry the more feature material we can include in each issue and the more useful the publication becomes to all concerned. The ABC thus performs an important function in the publishing field—and membership has come to stand for circulation integrity. It is a symbol of good reputation—one that cannot be purchased! —30—

This is what the newest and largest radio telescope now under construction in the United States will look like when it's erected in Green Bank, W. Va., as part of the National Radio Astronomy Observatory facilities there. The dish, which points skyward, is 140 feet in diameter and is capable of picking up radio waves transmitted naturally by objects in space, even when their total strength is less than one watt spread over the surface of the entire earth. Associated Universities, Inc., which operates the Observatory, announced that it has signed a contract with the E. W. Bliss Company of Canton, Ohio to build the telescope, which will rank as one of the largest such instruments.

Transistor FM Tuner

(*Continued from page 61*)

where each station tunes in; either one is correct. Slope detection doesn't eliminate all the background noise like a superhet FM tuner. Just tune the set for best audio quality.

Speaking of superhet FM tuners, the 3N25 transistor could very well be used as the oscillator, or mixer-oscillator, of a complete FM tuner. Surface-barrier or drift transistors could be used as i.f. amplifiers followed by crystal diodes as ratio detectors. This superhet would, naturally, be quite a bit more expensive than the superregenerative tuner.

Operation

The quench-frequency control, R_1, is set about mid-way through its rotation and the regeneration control shouldn't require resetting over most of the tuning range once it is properly adjusted. By adjusting the quench-frequency control around the operating center, you can actually change the bandwidth and, consequently, the frequency response of the tuner.

On some FM stations an audio tone is used to control leased receivers and thereby block commercials from these sets. When announcements or commercials are heard on such stations with this tuner, this tone will be audible as a result of the transmitted tone beating against the quench frequency. It could be filtered out but some loss of normal audio would result and the tone is really not loud enough to be annoying.

There is no noticeable tuner drift from day to day. There is nothing to warm up and nothing to get warm to cause drift. A friend remarked that along with instant foods and instant beverages, we now have "instant FM"!

The total cost of this tuner, using some junk-box parts, should not exceed $25.00. It's well worth this sum for the entertainment received in building something new and then listening to the results! -30-

"Pop, how's chances of using the computer tonight?"

Loading Cartridges

(*Continued from page 42*)

decreases and the output across this reactance decreases correspondingly. If the total circuit capacitance is increased by addition of a shunt capacitor, then, as previously explained, the load resistance must be correspondingly decreased to maintain the same time-constant as before. It may well work out that if the load resistance is 500,000 ohms, the additional shunt capacitance required may also provide a satisfactory amount of signal attenuation.

As pointed out earlier, treble boost is required when an amplitude-responsive cartridge is used (see Fig. 9). Ordinarily this is provided by the piezoelectric cartridge through mechanical resonance, controlled in amplitude and range by damping and other design techniques to approximate the RIAA equalization requirement.

It may be desired to convert the piezoelectric cartridge into a velocity-responsive device so that it may be fed into an input jack intended for a magnetic pickup. In most control amplifiers this has the advantage of allowing the user a choice of playback equalization characteristics, some intended for 78 rpm records and others for 33⅓ rpm discs made prior to the adoption of the RIAA curve.

There are two simple means for such conversion: (1) a small capacitor can be placed in series with the cartridge as shown in Fig. 12. This produces high-pass filter action so that output rises with frequency as in the manner of a magnetic cartridge, or (2) a small load resistor can be placed across the cartridge, as in Fig. 13. This, too, results in rising output with frequency.

(*Continued on page 128*)

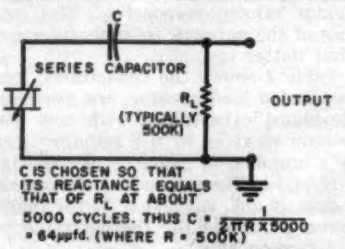


Fig. 12. Small series capacitor converts crystal pickup to velocity-responsive unit.

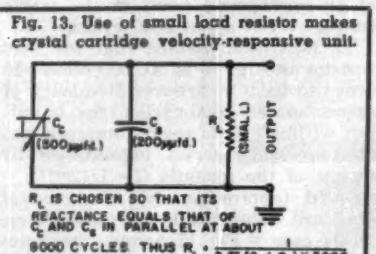


Fig. 13. Use of small load resistor makes crystal cartridge velocity-responsive unit.

CARTRIDGE	CAPACITANCE	RECOMMENDED LOAD RES.	MAXIMUM LOAD CAP. (Note A)	NETWORK FOR CONVERSION TO VELOCITY DEVICE
Astatic 81-TB	400 $\mu\mu$fd.	2 meg. (Note B)	100 $\mu\mu$fd. (Note B)	Fig. 14A
Astatic 89-TB	600 $\mu\mu$fd.	2 meg. (Note B)	100 $\mu\mu$fd. (Note B)	Fig. 14A
Electro-Voice 8D	300 $\mu\mu$fd.	3 meg.	100 $\mu\mu$fd.	Fig. 14B
Ronette TX-88	1500-1800 $\mu\mu$fd.	500,000 ohms	Note C	Fig. 14C
Shure ML-44	525 $\mu\mu$fd.	Fig. 14D	Note C	Fig. 14E
Sonotone 3T-S	490 $\mu\mu$fd.	2.2 meg. (Note D)	100 $\mu\mu$fd.)	Fig. 14G
Webster MC-1	510 $\mu\mu$fd.	.51 to 3.3 meg.	100 $\mu\mu$fd.	Note C
Zenith	500 $\mu\mu$fd.	1 meg.	100 $\mu\mu$fd.	Note E

NOTES: A = cable capacitance and input stage capacitance. This is the maximum load capacitance for the recommended load resistance. Higher load capacitances are permitted with smaller load resistances, as discussed in text; B = the manufacturer states, "Load resistance, in megohms, multiplied by total capacitance (cartridge, cable, etc.) should equal approximately 1000"; C = information not supplied by manufacturer; D = see Fig. 14F for alternate load network recommended by the manufacturer for maximum flatness of response; E = the manufacturer states, "We do not recommend the conversion of this pickup into a velocity device."

For information on cartridges not covered, contact the manufacturers direct.

Table 2. Characteristics and loading for representative piezoelectric cartridges.

Neither the series capacitor nor the shunt resistor should be so small as to produce high-pass action throughout the treble range. As already mentioned, the cartridge has built-in treble boost due to mechanical resonance. Therefore, the rise in output should level off at an appropriate point in the treble range, *viz.*, at about 5000 cycles.

To illustrate, assume that the load resistor in Fig. 12 is 500,000 ohms. In order to have a turnover frequency of approximately 5000 cycles (rise in output within 3 db of maximum), we find the necessary series capacitance by means of the formula $C = 1/(2\pi fR) = 64$ $\mu\mu$fd. (approximately). The nearest standard value would be satisfactory. In the case of Fig. 13, assume that total circuit capacitance is 700 $\mu\mu$fd. We find the necessary load resistance by means of the formula $R = 1/(2\pi fC)$. Using the figure 5000 cycles as f, R turns out to be about 46,000 ohms; a 47,000 ohm resistor will do.

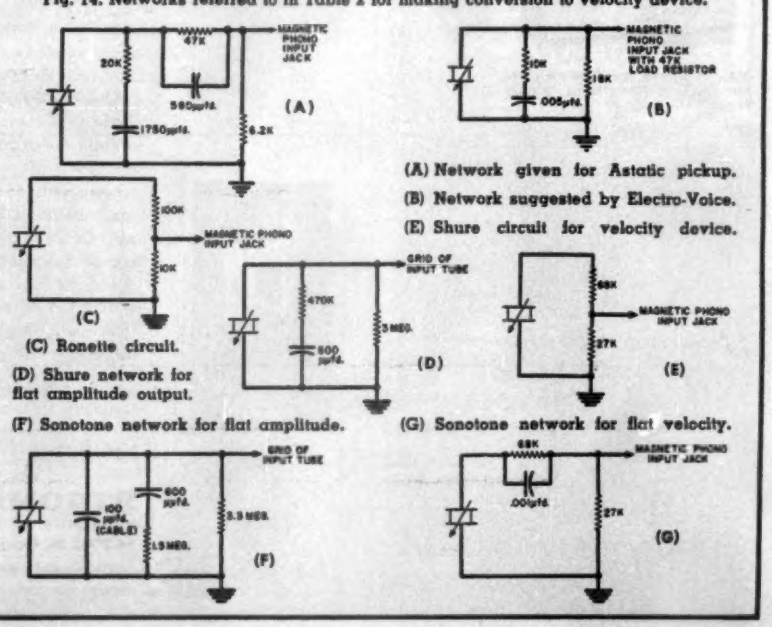
If signal output is excessive after the cartridge is converted to a velocity-responsive device, signal attenuation can easily be achieved by using a voltage divider as the load resistance. As long as the total load resistance is less than about 250,000 ohms, it is not likely that high-frequency loss, such as discussed in connection with Fig. 10, will occur.

Manufacturers of piezoelectric cartridges sometimes recommend a more complex network than a simple series capacitor or shunt resistor to make the pickup velocity-responsive. The purpose of the network is to obtain somewhat flatter response.

Table 2 shows the capacitance, recommended load resistor, and permissible shunt capacitance with this load resistor as given by the manufacturers of a number of popular piezoelectric cartridges. The table also indicates the means, if any, suggested by the manufacturer for making the cartridge velocity-responsive.

For those few special cartridges, such as the FM type, which do not fall in either of the categories discussed, the specific recommendations outlined by the manufacturer must be followed. Also, for information on magnetic and piezoelectric cartridges not covered in Tables 1 and 2, the cartridge manufacturer should be contacted for the correct information. —30—

Fig. 14. Networks referred to in Table 2 for making conversion to velocity device.



(A) Network given for Astatic pickup.
(B) Network suggested by Electro-Voice.
(E) Shure circuit for velocity device.
(C) Ronette circuit.
(D) Shure network for flat amplitude output.
(F) Sonotone network for flat amplitude.
(G) Sonotone network for flat velocity.

TRANSISTOR TERMINOLOGY

By JOHN A. COMSTOCK

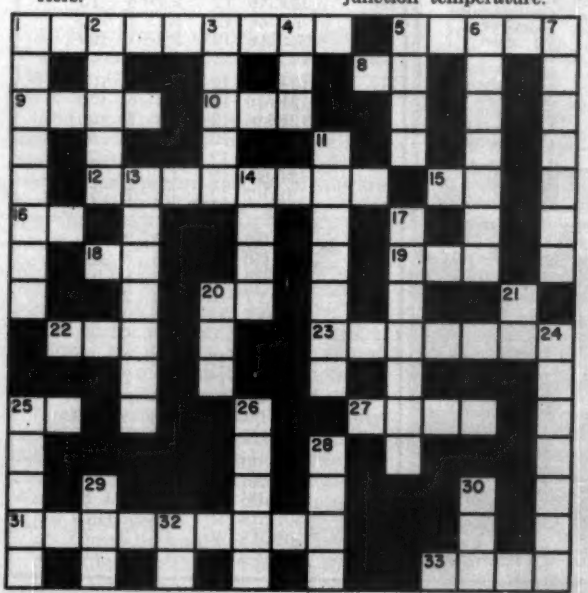
THIS year marks the tenth anniversary of the development of the transistor by three *Bell Telephone Laboratories'* scientists. Have you kept up with this revolutionary component? Test your knowledge. (*Solution on page* 165)

ACROSS

1. Semiconductor which is neither "p" nor "n," containing roughly an equal number of electrons and holes.
5. Current carriers in a semiconductor which are positively charged.
8. Parameter letters symbol representing a transistor's power output.
9. Maximum inverse voltage rating which a transistor can withstand without breakdown.
10. Collector cut-off current.
12. Semiconductor material found most often in rectifiers.
15. Symbol for transistor operating temperature.
16. D.C. collector current.
18. Transistor input impedance.
19. Forward current ratio (input a.c. open-circuited).
20. Junction of "n" and "p" areas in a semiconductor.
22. Metal button alloyed into base wafer of an alloy-type transistor.
23. A number of these particles carry current, specifically electrons and holes.
25. Parameter letters symbol for transistor output impedance.
27. One of the electrodes of a field-effect transistor.
31. Current carriers of a negative polarity.
33. Letters symbol for d.c. supply voltage base-to-emitter.

DOWN

1. Small addition to semiconductor, usually a donor or an acceptor.
2. Imperfections in a crystal which snare current carriers.
3. A transistorized preamp should generate minimum ———.
4. Parameter symbol for emitter cut-off current.
5. Four-layer transistor with built-in amplifier for a collector.
6. That portion of cut-off current caused by surface effects.
7. Semiconductor commonly used in transistors and crystal diodes.
11. Location of transistor barrier.
13. Electrode of a transistor corresponding to vacuum tube's cathode.
14. Intrinsic region-type transistor with "n"-type emitter and collector and "p"-type base (Abbr.).
17. Runaway condition in which transistor's heat dissipation increases with higher temperature at such a rate that temperature keeps rising.
21. Parameter symbol for common emitter power gain.
24. Small current flowing opposite to normal in a diode when an opposing potential is applied.
25. Reverse voltage at which a large current begins to flow, caused by crystal breakdown.
26. Impurity used intentionally to produce an "n"-type semiconductor.
28. One of the electrodes of a transistor.
29. Letters symbol for emitter-to-base d.c. voltage.
30. Letters symbol used to represent common base output admittance (input a.c. open-circuited).
32. Symbol for transistor's junction temperature.



New Tube Tester Data

Owners of Seco tube checkers: Keep up-to-date with this listing of the most recent tube types.

SECO MODEL 107

P.S.	Load	Type	Fil. V	F,Fj	Q	Load	Spec
		1K3	1	2.78	TC	100	D
		3Z4	1	17.5	3	100	B
9D		4ES8	4	4.5	2	80	
		4ES8	4	4.5	7	80	
7E	30	4DE6	4	3.4	1	30	
9D	2X25	5BS8	5	4.5	2	70	
		5BS8	5	4.5	7	70	
		5CG4	5	2.8	4	5	D
		5CG4	5	2.8	6	5	D
		5CM6	5	4.5	36	20	
		5CR8	5	4.5	2	70	
		5CR8	5	4.5	9	70	A
9G	30	5EH8	5	4.5	2	80	
	25	5EH8	5	4.5	7	80	
		6AF3	6	4.5	9	5	A
		6CK4	6	2.7	13	10	
		6DA4	6	7.8	5	10	
		6DE7	6	4.5	23	40	A
		6DE7	6	4.5	7	40	
9L		6DG7	6	4.5	2	50	
9D		6DJ8	6	4.5	2	80	
		6DJ8	6	4.5	7	80	
8G		6DN7	6	7.8	1	50	
		6DN7	6	7.8	4	50	
		6DR7	6	4.5	23	40	A
		6DR7	6	4.5	7	40	
		6DT5	6	4.5	36	20	
9G	50	6EB8	6	4.5	2	100	
	20	6EB8	6	4.5	7	20	
		6EF6	6	2.7	5	20	
9G	30	6EH8	6	4.5	2	70	
	25	6EH8	6	4.5	7	70	
		6EM5	6	4.5	36	15	
9D		6ES8	6	4.5	2	80	
		6ES8	6	4.5	7	80	
7E	25	6EW6	6	3.4	1	60	
		6FH8	6	2.7	5	15	
		6H8	6	2.7	TC	85	
		6H8	6	2.7	4	85	40
		6H8	6	2.7	5	85	40
		7EY6	7	2.7	5	20	
		8BQ5	8	4.5	2	15	
		8CY7	8	4.5	3	25	A
		8CY7	8	4.5	7	100	
9G	50	8EB8	8	4.5	2	100	
	20	8EB8	8	4.5	7	20	
		8EM5	8	4.5	36	15	
		9EF6	9	2.7	5	20	
		11CY7	12	4.5	3	25	A
		11CY7	12	4.5	7	100	
		12AD5	12	4.5	2	60	
		12AF3	12	4.5	9	5	A
		12D4	15	7.8	5	10	
		12DF7	12	4.5	2	70	
		12DF7	12	4.5	7	70	
		12DK7	12	4.5	1	100	
		12DK7	12	4.5	6	100	
		12DK7	12	4.5	9	100	A
		12DQ7	12	4.5	2	25	
		12DS7	12	4.5	3	60	
		12DS7	12	4.5	1	100	
		12DS7	12	4.5	9	100	A
		12DT5	12	4.5	36	20	
		12DV8	12	4.5	3	100	
		12DV8	12	4.5	1	100	
		12DV8	12	4.5	9	100	A
		12DW8	12	4.5	2	100	
		12DW8	12	4.5	7	100	
		12DY8	12	4.5	1	50	
		12DY8	12	4.5	9	100	A
		12DZ6	12	3.4	1	100	
		12EA6	12	3.4	1	100	
		12EC8	12	4.5	1	70	
		12EC8	12	4.5	9	70	A
		12ED5	12	3.4	25	25	
		12EF6	12	2.7	5	20	
7E		12EK6	12	3.4	1	90	
		12EM6	12	4.5	1	100	
		12EM6	12	4.5	9	100	A
8D		12EN6	12	2.7	5	15	
		12EZ6	12	3.4	1	100	
		12FA6	12	3.4	1	100	
7D		12FM6	12	3.4	1	100	
		12FM6	12	3.4	5	100	
		12FM6	12	3.4	6	100	
		13DE7	12	4.5	23	50	A
		13DE7	12	4.5	7	70	
		13DR7	12	4.5	23	50	A
		13DR7	12	4.5	7	70	
		14G6	12	4.5	2	100	
		14G6	12	4.5	6	100	
		14G6	12	4.5	8	100	
		14Y7	12	4.5	2	70	
		14Y7	12	4.5	9	70	A
		17C8	15	4.5	2	80	
		17C8	15	4.5	7	100	
		17C8	15	4.5	8	100	
		17D4	15	7.8	5	10	
		25EH5	25	3.4	25	15	
		38A3	35	4.5	9	10	A
		45B5	45	4.5	2	15	
		50BM8	50	4.5	1	70	
		50BM8	50	4.5	3	70	
		55N3	50	4.5	9	10	A

Service Holds a Convention

(*Continued from page 57*)

many in the east, who were in Chicago for very much the same reasons Teskey was.

Fortunately, we can report a happy ending. We talked to you. Since you were understandably one of the busiest men at the convention, we also talked to Al Saunders, Verne LaPlante, Bert Bregenzer, and a number of others of your capable associates. In trying to set the record straight, we learned that some thought had already been given to the matters of press coverage and Frank Teskey by all of you, and that a re-appraisal was in the works. Your invitation to let us sit in on the remaining meetings, which came soon thereafter, was a welcome turn of events. In fact, it ended well for all of us, observers and participants.

Once inside the meeting room, we got another view of things. We saw an active group going about its business in a democratic way. We saw everyone who had something to say being given his chance. We saw no highwaymen. We saw the "tyrant," Frank Moch, being cut down at times by the chairman's gavel and finding some disagreement in a peaceable, above-board fashion. We heard one outside observer say, "I wish we could get this sort of interest and activity in our own local meetings."

We heard the Teskey matter openly discussed and noted the general agreement that it would be wise to hold it for the final session to avoid interference with the completion of unconcluded convention business.

At the final session, we saw Teskey invited to state his business. We heard forthright answers to most of his questions from you and careful explanations as to why certain others could not be answered fully. We were also told by Teskey and other observers for non-NATESA groups that they considered the answers generally good ones, providing a large step in the direction of reconciliation.

And what of the lessons we mentioned earlier? We can now see why, oversensitized by a long struggle for recognition against long odds, you are worried about the damage that enemies may do. However, secrecy is the wrong weapon to use against snipers. As long as you are clean, your best defense is working out in the open as much as possible. NATESA is big now, and the concern of everyone in service. Compare the damage that was almost done to the good finally accomplished by a forthright approach.

Again, thanks for the opportunity of taking part in an exciting service event. We hope to run the Teskey questions next month, with answers. We also look forward to seeing you again next year.

Cordially yours,
Sidney C. Silver, Service Editor
RADIO & TV NEWS

"BASICS OF DIGITAL COMPUTERS" by John S. Murphy. Published by *John F. Rider Publisher, Inc.*, New York. Three volumes ($2.50 each, $6.95 the set). Soft cover.

As the title of this series implies, this is a primer for those interested in acquiring a broad background in computer theory. In "picture-book" form, the author covers the development of computers, basic theory of computer arithmetic, data representation, program, "and/or" circuitry, and control in his first volume.

The second volume discusses the logical elements, circuits, typical types of signals, and magnetic cores which are then combined to show a few of the less complex units such as encoders, decoders, counters, and adders as used in computers. The final book in this trilogy covers types of memory, control system, and input-output equipment of computers as a whole. Timing is also given extensive treatment.

Since the discussion is progressive and the material clearly written and lavishly illustrated, there is no reason why this series cannot be used as a "home-study course" by those with some knowledge of electronics who want to break into the broader field of data processing.

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"PIN-POINT COLOR TV TROUBLES IN 15 MINUTES" edited by Harold P. Manly & Coyne Technical Staff. Published by *Coyne Electrical School*, Chicago. 548 pages. Price $5.95. Spiral bound, soft cover.

This practical manual for the service technician has been based on the "Check-Chart" system of troubleshooting developed by Mr. Manly. The book covers 150 types of faulty pictures with over 1000 troubles responsible for such results. A detailed system of cross-referencing permits the rapid location of these picture faults. Check-charts are used extensively to point up possible trouble sources.

Among the receiver circuitry covered in this book are the antenna, tuner, i.f. amplifier, picture detector, a.g.c., *Y* amplifier, chrominance bandpass amplifier, matrices, chrominance demodulators, one- and three-gun picture tubes, picture input tubes, basic and final color tube set-ups, burst amplifier, burst phase detector, reactance tube, subcarrier oscillator, color killer and automatic chroma control, vertical and horizontal sync, deflection yoke, deflection, sound, and dynamic convergence.

An eight-page picture-pattern section in full color is a "plus" feature which should prove especially helpful to the practicing technician.

Those now concerned with color TV service work should find this volume immediately useful in cutting trouble-shooting time while those who have yet to encounter their first color job would be well advised to have a copy on hand for future reference and anticipatory study.

* * *

"ELECTRON-TUBE CIRCUITS" by Samuel Seely. Published by *McGraw-Hill Book Company, Inc.*, New York. 680 pages. Price $10.50. Second Edition.

In this revised and enlarged edition of a volume which originally appeared in 1950, the author has added considerable new material covering the analysis of *RC* feedback amplifiers, FM discriminators, electronic computing circuits and devices, and the theory of clamping. He has also expanded his original treatment of such topics as feedback, solid state electronics, transistors, and transistor circuit theory in addition to providing new problems for the student.

The author and his book are too well known in classrooms throughout the country to require any detailed analysis. The text is divided into twenty chapters and four appendices and provides painstaking coverage of practically every type of circuit or device using vacuum tubes. The appendices include network theorems, plate characteristics of vacuum tubes, characteristics of transmitting tubes, and a table of Bessel functions of the first kind to make the text self-contained.

Would-be users of this text are advised to have their basic mathematical techniques well sharpened and in good working order before tackling this volume.

* * *

"TRANSISTOR MANUAL" compiled and published by Semiconductor Products Dept., *General Electric Co.*, Syracuse, N. Y. 168 pages. Price $1.00. Spiral binding, soft cover. Third Edition.

This new and revised manual contains a wealth of information which will be of interest to circuit designers, hobbyists, and experimenters. Three early chapters cover basic semiconductor theory, transistor construction techniques, and biasing while the balance of the text is devoted to specific and practical applications of transistors.

Separate chapters on basic amplifiers, hi-fi circuits, radio circuits, unijunction transistor circuits, transistor switches, and logic contain both schematic examples and explanatory text. Four final chapters deal with tetrode transistors, the silicon-controlled rectifier, power supplies, and transistor specifications. A circuit diagram index and bibliography complete the book.

Those with a more-than-casual interest in transistors and transistor circuitry will enjoy and profit by a serious perusal of this manual.

* * *

"TAPE RECORDER MANUAL" compiled and published by *Howard W. Sams & Co., Inc.*, Indianapolis. 160

pages. Price $2.95. Soft cover. Vol. 2.

This is the second volume in this publisher's new series covering current-model tape recorders. The manual includes information on 16 models produced during 1957—15 monaural and one stereo unit.

Both home and professional models are covered with complete information on general operational data, use of external speakers, mechanical and amplifier adjustments, cleaning, lubrication, etc. For each recorder covered the text provides information on troubles and probable remedies plus complete mechanical and electrical component parts listings.

Photographs show the actual recorder and amplifier with exploded view diagrams providing the complete assembly and parts lists information. Amplifier schematics are included where applicable. A cumulative index for Volumes 1 and 2 is also provided.

Both service technicians and technically minded audiophiles will find this manual helpful.

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"SINGLE SIDEBAND FOR THE RADIO AMATEUR" edited by ARRL Headquarters Staff. Published by *American Radio Relay League*, West Hartford, Conn. 212 pages plus catalogue section. Price $1.50 (U.S.), $1.75 (outside continental U.S.).

The enlarged and expanded edition of this "bible" for SSB amateurs is a compilation of the best articles on the subject of single-sideband which have appeared in *"QST."* Careful revision and editing makes the presentation complete without being repetitious. Both theory and practice are covered.

The individual articles have been arranged so that the contents can be presented in orderly progression under eight specific categories: introduction and historical background, modulation, detection, filter systems, receivers, phasing system, linear amplifiers, and accessories. The text is profusely illustrated with charts, tables, formulas, schematics, and photographs.

It would be hard to find any other single source that provides as much information on SSB in as concise and practical a form as can be found in this comprehensive manual—a "must" for the radio amateur who is operating SSB. —30—

Antenna News

TV ANTENNA ROTORS

The Accessory Division of *Philco Corporation*, "C" & Westmoreland Sts., Philadelphia 34, Pa. has added four new television rotors to its line of TV accessories.

The newly designed control box measures $5\frac{13}{16}$" wide by $4\frac{11}{16}$" deep. The top of the control contains the meter and slopes up to a maximum height of $5\frac{5}{8}$". A horizontal rocker-bar actuates the rotor. Since this involves vertical pressure, any tendency to push the control sidewise is eliminated.

New features for the installer include an adjustable meter indicator, similar to a "zero-adjust" on a conventional meter. This permits more accurate adjustments to be made for line voltage and lead length than were possible with the potentiometer used in previous models.

The motor unit is new in appearance and the entire housing is cast aluminum, providing an unusually tight weather seal. The models currently available are the P-15 (mahogany); P15B (blonde); P-16 (mahogany with thrust bearing); and P16B (blonde with thrust bearing).

SWEPT-WING AUTO ANTENNA

The Tenna Mfg. Co., 7580 Garfield Blvd., Cleveland 25, Ohio has developed a new auto radio antenna which features the swept-wing styling of the 1958 passenger cars with which it is designed to be used.

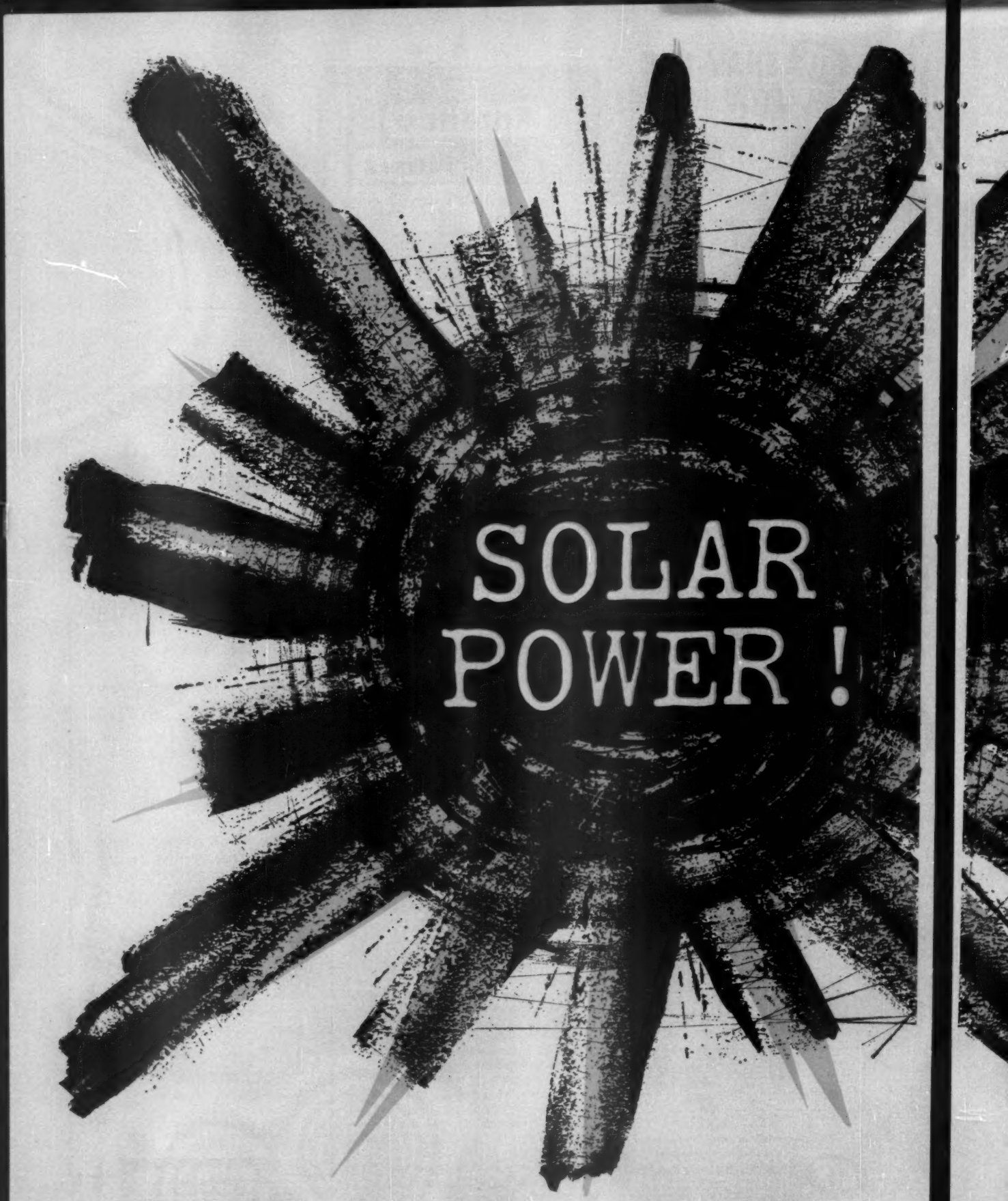
The Model JA-7 "Bullet" antenna can be mounted on any car cowl or fender contour. It comes with two chrome, die-cast swivels which permit vertical or 45-degree angle mounting of the removable mast and two plastic base mounting pads for any car contour. Quick top installation is provided by a special mounting toggle which is supplied with the antenna.

"WONDER WAVE" FRINGE UNIT

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y. has added the "Wonder Wave" all-channel broadband unit to its 1958 line of power antennas.

Designed for both black-and-white and color reception, the antenna provides extra gain for fringe areas, features a low silhouette to reduce wind drag, and automatic snap-lock brackets and insulators for maximum security. An added feature of this model is the firm's "Quadro-Grip" U-bolt assembly which grips and secures the antenna crossarm to the mast four times, preventing turning and slipping of the antenna on the mast.

The series is currently being offered in two models: WW-75 and the WW-150 stacked for double power. —30—


SOLAR
POWER !

By BERT WHYTE

AS many of you are probably aware, some of the very first stereo discs were the product of *Sudgen Company* in England and it is also rather well known that *London Records*, through the parent *Decca Company* of England, has been experimenting with vertical/lateral stereo recordings for the past few years. So you might say our English cousins got the jump on us in this field, even though they, as well as we, subsequently adopted the *Westrex* 45-45 system. This is by way of preface to telling you that I spent considerable time in England this summer and was able to observe first-hand what the situation is there with regards the stereo disc as well as other hi-fi phenomena.

There is a large and active electronics firm in England called the *Pye-Nixa* group. It has, for some time, been making recordings of various British orchestras and has alliances in America with the *Vanguard* and *Mercury* companies and at one time did considerable recording for *Westminster*. It was the first company in England to jump on the stereo disc bandwagon and as soon as it was set that the *Westrex* 45-45 system was to become the industry standard, the firm hurriedly issued a number of recordings made in this new stereo process. The company used certain material of its own as well as program which had been recorded by associate companies. I listened to some of this material during the early part of my visit and unhappily found that it was extremely poor. I have recently learned that most of this original batch of recordings has been withdrawn from the market and it is rather obvious that someone "goofed."

This is clearly a case where too much enthusiasm prevailed over the hard facts of stereo disc engineering. I bring this story to your attention to emphasize the fact that the stereo disc is still in its infancy and I am afraid we have had similar occurrences in our own country. No one denies that the stereo disc is a great thing and that it certainly is an item for exploitation. But it is to be hoped that common sense will prevail and there will be less scrambling for the so-called privilege of being "first" and more attention to turning out a good workable and enjoyable product.

As far as *Pye Limited* is concerned, I believe it is re-cutting all its masters and so has left the field to *EMI* and *Decca*. There is nothing much from *Decca* in the stereo disc field as yet, but *EMI* has issued a few discs which are very difficult to obtain. From what I have heard thus far, it seems that *Decca* (or *London*, as it is in the U.S.) still enjoys a marked advantage with the quality of its stereo disc.

Despite the debacle of the first stereo releases in England and the scarcity of subsequent issues, stereo discs are almost as big a catchword in England as they are in the United States. Hi-fi enthusiasts there are busily engaged in revamping their systems so that they may play the new stereo discs and the English component manufacturers have been quick to capitalize on this with a rash of single chassis stereo amplifiers and many varieties of matched speaker ensembles.

In England the commercial counterparts of our own *Admiral, Philco, RCA, Motorola*, etc., have moved in on the stereo disc field with equal directness, if not equal speed. In practically all of the big London record and radio appliance shops (and there are literally hundreds of them) you can see not one but many makes of stereophonic disc playback equipment. I do not know whether this name is trade-marked or is more or less generic, but seemingly all these units are called "Stereograms." Many of these emanating from the *Pye, EMI,* and *Decca* groups are of the packaged variety equivalent to our radiophonograph affairs and these are rather more prominently featured than the component systems. I have listened to a few of these units and must confess I was not overcome with joy at the sound of any of them and would say that, on the whole, they are no better nor no worse than our own makes in this category.

There was one detrimental feature which seemed fairly common with most of these models and which, I am afraid, is something that will be very difficult to correct . . . namely, speaker separation. Especially in the all-in-one varieties this separation is extremely small and unless some acoustic trickery can be employed, the stereo effect will be greatly diminished. The average English living room is quite a bit smaller than its American counterpart and this, of course, accounts for the manufacturers trying to incorporate a stereo system into as little space as possible. We are guilty in this respect too, but neither as extremely so, nor as universally so as in the English instruments.

However, quite a number English manufacturers have adopted the idea, also put forth in America, of using a centrally located unit containing the record player, both amplifiers and a speaker system for reproduction of bass frequencies only, then two small speakers can be placed on either side of the central reproducer or in corners to supply the middle and high frequencies. This arrangement is based on the theory that bass frequencies (below 500 cycles) are non-directional. There has been considerable argument on this point and I, myself, do not feel that it is altogether true, but some of the setups I have heard seem to work reasonably well. Of course the same rules apply to stereo as apply to normal hi-fi reproduction.

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

In other words, just because you're dealing with stereo doesn't mean that one can get away with using very small speakers of indifferent quality and expect to have really good results. I keep on emphasizing this point because it is too easy to fall into the trap of thinking that stereophonic reproduction is some sort of panacea which will magically correct speaker deficiencies. If you have a top quality monaural hi-fi system and you expect the same quality in stereo, I am afraid you will simply have to pay the piper and duplicate the quality of your present system in the second channel.

Such special stereo amplifiers and matched speakers as I have listened to have excellent quality and no doubt many of them will find their way into American homes. This is particularly true in the case of *Leak*, *Wharfedale*, and other high quality English makes.

While there seems to be a great deal of stereo disc activity in England, the stereo tape situation has been brought to a virtual standstill. Stereo tape was never exploited in England as it was in the United States and the advent of the stereo disc has put a quietus on the tape market until such time as an evaluation can be made of the effects of the stereo disc. What may be of interest to some is that the English recording companies may undertake (to use Mr. Dulles' expression) "an agonizing re-appraisal" of their stereo recording methods. I say this because a number of companies have ordered standard *Ampex* 3-channel, ½-inch recorders and are evidently going to try our widely separated 3-channel technique rather than continue with their so-called "MS system" which employs two microphones hung from a single central position with one mike in the cardioid position and the other in a figure-8 pattern. But perhaps underlying this move is the knowledge that the inter-channel separation on a stereo disc cutter is, in itself, not what could be desired and the wide-spaced 3-channel technique assures better separation than the MS system. In any case, despite individual purchasing power far below the American standard, our English friends are keenly enthusiastic about stereo discs and a great many of them are planning early conversion of their systems for stereo use. Thus as the market grows here, and the English enthusiasts begin to make their demands for repertoire on the English recording companies, this will be reflected to us and we can look forward to a steady supply of fine English stereo recordings. The New York Hi-Fi Show comes a little earlier than usual this year and if all goes well, and the deadline of this column and the show date coincides reasonably, I will be able to bring you a report on what certainly should be the most momentous and exciting hi-fi show ever held.

TED HEATH PLAYS AL JOLSON CLASSICS

Ted Heath and his Orchestra. London LL1776. Price $4.98.

Take the songs Al Jolson made famous over the years, then turn loose a really good "big band" arranger, have Ted Heath and his orchestra play them with scintillating verve and dash, and have *London* afford them its best recording and you have a disc that I think is a real winner. The old Jolson songs have been so unmercifully beaten to death and sentimentalized beyond all good taste that it is a real joy to hear them in this upbeat fashion, as fresh and alive as ever. The arrangements are quite outstanding, with the best of the lot "Sonny Boy," "I'm Just Wild About Harry," and "My Mammy."

Ted Heath seems to be enjoying his work here as the band really plays with snap and precision. *London* has gone all out on the sound of the brass especially . . . big, bright

and brazen, with ultra-sonorous saxes and sharp punchy percussion of exceptional clarity. If you can't smile with this one, Jack, life must be dull indeed!

BERLIOZ

SYMPHONIE FANTASTIQUE

Paris Conservatory Orchestra conducted by Ataulfo Argenta. London Stereo CS-6025. Price $4.98.

London continues to set the pace in the stereo disc field and as evidence of this, one has only to listen to this recording of the "Symphonie Fantastique". While the late Argenta was mostly given assignments by *London* embracing the Spanish repertoire, it was obvious from his excellent musicianship that he would have been able to cope with repertoire of other types.

I would not call this the very best reading of the "Symphonie Fantastique", but it is certainly one of the most exciting. Argenta takes the "Witches' Sabbath" and "March to the Gallows" sections at a very fast pace which will draw reproving frowns from musicologists. Be that as it may, it is hard to deny the vigor and passion of Argenta's reading as being anything but enjoyable.

The *London* engineers have afforded a stereo perspective which illuminates, as never before, all the musical nooks and crannies of this work. The sonorous throb of the "Dies Irae" never sounded so grim and the brazen clangor of the big bell near the end sounds like the knell of doom itself. Throughout the work directionality was excellent and readily apparent, there was excellent forward projection with no holes-in-the-middle and although the recording was a little closer than some other of *London's* stereo, the illusion of depth was reasonably well maintained. My only quibble here is some slight over-cutting near the very end which causes the sound to become somewhat jumbled and lose its articulation and some of its stereo separation. As with most *London* stereo, surfaces were pleasingly quiet and all-in-all it can certainly be recommended as one of the better examples of present stereo disc recording.

BRAHMS

SYMPHONY NO. 1

Vienna Philharmonic Orchestra conducted by Raphael Kubelik. London Stereo CS-6016. Price $4.98.

There are people who will insist that the music of Brahms and certain other romantic composers gains very little in stereo format. I must confess that I too have felt this way on occasion, but have for some time now revised my opinion because I came to realize that it is not Brahms or the others who are so much at fault as the recording engineers who fail to "think stereophonically." What is a good pickup and balance for Brahms monaurally is not necessarily the type of pickup and balance that should be used for a stereophonic recording. If the stereo medium is intelligently utilized and the engineers dispense with any preconceived and hide-bound notions, Brahms can be as stereophonically delectable as Stravinsky or Bartok.

All this is by way of telling you that while the *London* engineers have not succeeded entirely in this recording of the Brahms work, they have none the less done an excellent and well thought out job and have afforded us a fresh and new insight to recordings of Brahms' music. For instance, the very opening of the Brahms "First Symphony," which even in the best monaural recordings never seems to sort out or separate the orchestral components, in this case is accomplished very neatly. The tympani beat is very clean and articulate and the strings do not sound as if they were going in all different directions, but are clearly defined

and each choir has its proper weight and tonal value. (By the way, just for fun, if you think you can whistle most symphonies easily and are proud of this, just try your talents on the opening of Brahms "First.")

As the work develops one can clearly hear the directional aspects and the superior separation of all the instruments and yet while all this is apparent, it is also clear that there is no loss of homogeneity. In fact, the sense of fullness and bigness that characterizes Brahms is more completely realized than ever before. The reverberation of the hall in which this was recorded, has been handled in a most salutary manner so that among the big plus values of a stereo recording of Brahms' music, is the sensation of depth which here gives a rounded spaciousness and sense of "presence" totally absent in monaural recordings.

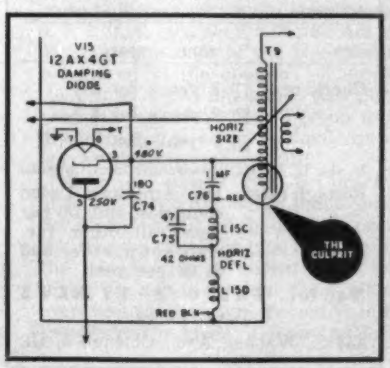
Kubelik has done this Brahms "First" before for *Mercury* and while that was a good recording and performance, it is easy to perceive that Mr. Kubelik now takes a more mature viewpoint of the work and this performance is much more convincing. His is a powerful reading which, however, has not neglected lyricism. There undoubtedly will be those who will call the approach too lyrical but I, for one, like this rather than another dose of the usual Teutonic heavy-handedness. Thus the recording, while not definitive, is certainly different and although different, most enjoyable, and with the virtues of stereophonic added to all this, the Brahms "First Symphony" seems a little less hackneyed, especially to the ears of critics who have listened to umpteen versions of it monaurally! —30—

SOLUTION TO BENCH PUZZLER NO. 3

(*See page* 108)

IF YOU got this one right on the nose, the reason may be that you weren't thinking completely logically! With high voltage still present and an absence of vertical sweep, one of the vertical components would appear to be indicated. Nevertheless, a winding in the horizontal-output transformer (see diagram) was open. Although a fault like this will generally knock out the high voltage, the latter managed to limp along despite the defective transformer winding. Helping it may have been the fact that the fault also lightened the load on the horizontal-output and high-voltage section, since drain on the boosted "B+" voltage by the vertical-output stage was effectively removed as a result of the fault.

Have you come across an interesting service job lately? Send it to the "Puzzler" Editor, RADIO & TV NEWS, *using this format. We will pay for items used at regular rates. Others will be returned.*



Preset Counters

(*Continued from page 47*)

flip-flop stage will produce an output pulse. This pulse reverses the condition of the switching flip-flop and a positive pulse from one of its plates fires thyratron *Y*. As a result, the four flip-flop stages are now preset for a count of *Y*. After *Y* input pulses have been applied, an output from the fourth stage again reverses the switching flip-flop. A positive pulse from the opposite plate of the switching flip-flop now fires thyratron *X* and the counter flip-flops are again reset for a count of *X*.

Another method of obtaining an output pulse after any desired number of input pulses is shown in Fig. 5. The *diode matrix* shown here consists of an array of vertical and horizontal wires, some of which are connected by means of diodes. Each horizontal wire is connected to a flip-flop plate, and the vertical wires are connected through resistors to a source of voltage.

As input pulses are applied to the flip-flops, output pulses will appear in succession at terminals 0, 1, 2, and 3. Each output terminal in Fig. 5 is numbered to indicate the quantity of input pulses required to activate that particular terminal. An output pulse will appear at terminal 1, for example, when the first input pulse is applied; terminal 2 will yield an output on the second input pulse; etc. Why this occurs will be explained later. The circuit therefore acts like a multi-position switch: with each input pulse, the output switches to the next terminal. Such circuits are, in fact, often used for multiplexing and other switching applications. Unlike mechanical switches, which are extremely limited in speed of operation, circuits like that shown in Fig. 5 are capable of switching in excess of a million times per second.

For simplicity of explanation a two-stage flip-flop circuit is shown in Fig. 5, but the same method may be extended to a greater number of stages.

Each vertical wire is connected through a resistor to a single voltage source at the top of the illustration. If one or more of the diodes along any one vertical line is conducting, most of the supply voltage will be dropped across the resistor and the output terminal of that line will be at a low potential. If, however, none of the diodes along the vertical line are conducting, there will be no voltage drop across the resistor and the full supply voltage will appear at the output terminal. An output terminal is therefore active only when *all* of the diodes connected to it are in a non-conductive state.

Whether or not a given diode conducts depends upon the condition of the flip-flop tube to whose plate it is connected. If the tube is cut off, its plate voltage will be high and the diode will be back-biased or non-conductive, as shown in Fig. 3A. If the tube to which the diode is connected is conducting

(Fig. 3B), its plate voltage will be low and the diode will be biased in the forward or conducting direction. The diodes along any given vertical line should therefore be connected to the plates of those tubes which will be at cut-off after the desired number of input pulses.

Note that in Fig. 5 the diodes connected to vertical line 0 are controlled by tubes V_1 and V_8. Table 1 shows that these tubes will be cut off at the start (zero input pulses). Terminal 0 is therefore "live" before any input pulses have been applied to the flip-flop stages. Notice also that every other vertical line has at least one conducting diode and therefore yields no output.

When the first input pulse is applied to the circuit, the first stage will switch to the 1 condition as shown in Table 1. Tubes V_2 and V_3 are now cut off and the diodes connected to these tubes become non-conductive. Under these conditions, there will be no voltage drop across resistor R_2 and terminal 1 will therefore be active. Notice again that each of the other vertical lines has at least one conducting diode. As can be seen from Table 1, the second input pulse will cause V_1 and V_4 to cut off and the voltage at terminal 2 will increase.

The method just described for two stages can be extended to a greater number. For each additional flip-flop stage, two more horizontal wires are used. The number of vertical wires is doubled each time a stage is added. The maximum number of output terminals (vertical wires) is equal to the maximum ratio of the counter which, in turn, depends upon the number of stages. If five flip-flop stages are used, the maximum ratio will be 2^5 or 32 and the circuit will permit the use of this number of output terminals. Likewise, an eight-stage circuit will permit the use of a maximum of 2^8 or 256 output terminals.

In practice, the number of vertical wires actually used depends upon the requirements of the particular application.

It is of interest to note also that the diode matrix becomes, in effect, a binary-to-decimal converter. Assume, for example, that a diode matrix is connected to a five-stage flip-flop circuit and that a neon bulb is connected to each of the 32 output terminals. If these bulbs are numbered in succession 0, 1, 2, 3, 4, etc., they will indicate the decimal equivalent of the binary number stored in the counter. When the conditions of the five stages are 11010, neon lamp number 26 will be on to indicate that this is the decimal equivalent of binary number 11010.

Since an output can be obtained after any given number of input pulses, the diode matrix can be used to preset the counter. For this type of operation, the preset relay or thyratron is triggered by a pulse taken from whichever vertical line will be active after the desired number of input pulses.

—30—

THE "ISTOR" STORY

By **RUDOLF F. GRAF**

How many of these "istors" can you describe, identify?

CHRONISTOR: A subminiature elapsed-time indicator whose operation is based on the principle of electroplating. As current (approx. 1 ma.) passes between the terminals, ions are carried from the cathode to the anode. The unit is the size of a standard 3AG fuse and will indicate from 100 to 2000 hours "full scale." (Bergen Laboratories)

FERRISTOR: A miniature two winding saturable reactor which will operate on a high carrier frequency. It may be connected as an oscillator, free-running multivibrator, current discriminator, coincidence gate, or ring counter. (Beckman Instruments)

MAGNISTOR: A small saturable reactor used to control electrical pulses or sine waves from 100 kc. to 30 mc. at power levels up to tens of watts. It can be used to gate, switch, amplify, count, and register. (Potter Instrument Co.)

PERSISTOR: A miniature bi-metallic printed circuit loop operating near absolute zero. Its operation is based on the superconductivity characteristics of some metals at low temperatures. "Persistor" finds use as a computer element for switching and storage. (Ramo-Wooldridge Co.)

RESISTOR: A circuit element offering opposition to the flow of current.

SPACISTOR: A four terminal transistor (base, collector, injector, and modulator) which ultilizes a reversed bias "p-n" junction to create a space charge region for a very short transit time. Has an estimated frequency limit of 10,000 mc. input and output impedances of about 30 megohms, and may be operated at temperatures up to 500° C. (Raytheon)

STABISTOR: A silicon diode which maintains an essentially constant voltage drop of 0.5 volt in its forward direction. (Transitron)

THERMISTOR: A temperature-sensitive resistor with a high negative temperature coefficient used for temperature compensation, time delay, switching, power measurement, and instrumentation. Available in bead, disc, or rod construction. (Veco, G-E, Western Electric, and others)

THYRISTOR: A high-current, high-speed (0.00000002 sec.) switching transistor which may also be used as a high-frequency amplifier. This modified alloy junction transistor switches from on to off stage by means of low energy pulses applied to the base circuit. (RCA)

TRANSISTOR: A crystal-type amplifying device made of semiconducting materials such as germanium or silicon operating on the principle of electron flow within a solid.

TWISTOR: A new "memory" system developed by Bell Telephone Laboratories. Its name stems from the fact that the magnetization direction of a wire made of magnetic material changes from lengthwise to helical if the wires are twisted. Thus, memory matrices can conceivably be made without magnetic cores.

VARISTOR: A network of four carefully selected and matched (within 1 ma. at ± 1 volt) diodes. Useful in bridge circuits or as a balanced modulator for carrier suppression. (Sylvania) —30—

always be resistive. Under these conditions, only very small components of reflection and phase shift are seen.

The values of isolation capacitors for typical isolation losses are given in Table 2. Such losses vary according to the efficiency of the circuit and the type of matching network used. With a circuit such as that of Fig. 7, values may run 10% or more and higher both on isolation and feedthrough losses. Fig. 8 is a photo of a typical surface-mounted tap-off unit for use with RG-59/U cable.

Examination of Table 2 will show the reasoning behind the capacitive tap. As an example, take the action of the 5-μμfd. capacitor. At channel 2 this shows an isolation of 19 db. With such an isolation it can be expected that the tap will be some distance from the amplifier. Channel 13 levels, therefore, will have been dropped considerably below the level of 2. We find that the isolation at channel 13 is 9 db, so that the channel-13 level will be cut down through the tap by an isolation loss which is lower by 10 db. When excessively long lines are used, this correction is not enough and some means must be used to start the line off with higher levels of signal at the high band. This is covered under the discussion on the amplifier.

V.H.F. Amplifiers

Amplifiers for use at v.h.f. can be classified under two headings: preamplifiers and distribution amplifiers. Each category may be sub-divided again into single-channel or broadband types. Many installations can be completed using only one broadband preamplifier, especially where levels of signal of a few thousand microvolts are available at the antenna. We will first discuss the requirements of a preamplifier.

A typical broadband preamplifier will have a gain in the neighborhood of 25 db and its response will be "flat"; that is, it will amplify equally well on all the TV channels. The one necessary characteristic that distinguishes the preamplifier is that it is designed with a low-noise input circuit, usually of the cascode variety. A good example of such a preamplifier has a noise input figure of 6 db low-band and 7.5 db high-band. In terms of signal, this means that about 70 microvolts low-band or 90 microvolts high-band will give satisfactory pictures from the output of these preamplifiers. Below this level, the internal noise produced in the elements of the antenna, tuning inductors, and tubes will produce a snowy picture in any event.

Such amplifiers are usually stagger-tuned, as are the i.f. stages of a TV set, and are aligned by quite similar but more elaborate techniques. In general, they consist of two amplifiers with inputs and outputs mixed on a common chassis and with a common power supply. One amplifier covers the low band

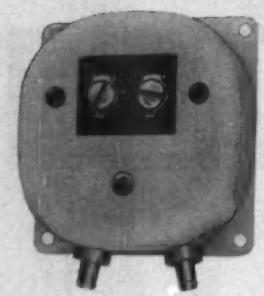


Fig. 8. The Jerrold LT-310—a typical surface-mounted tap-off for RG/59U line.

(2 to 6) and the other the high band (7 to 13). Developed response curves will be somewhat similar to Fig. 9. It can be seen that these amplifiers do not, as a rule, cover the FM band (88-108 mc.). They may be rated in terms of variation in response, usually a figure such as "± 1 db across the band." An important secondary consideration is impedance match, especially at the input terminals. This will be quoted in terms of voltage-standing-wave ratio (v.s.w.r.). Obviously, the closer this number is to 1.0, the better the match. Very rarely are outputs matched—mostly they are designed for optimum efficiency consistent with cost. This is acceptable as long as the output *sees* a good match. There can be no reflections from a matched load.

Single-channel preamplifiers are usually used in the special cases of very elaborate systems. With multi-channel operation, the broadband type offers greater economy. Both types are available in two physical styles: for mast-mounting or for indoor or cabinet use. The mast-mounting types are for use where minimal signals are being received and offer the advantage—a considerable one—that the antenna signals are amplified before they can be attenuated by the downlead or before the downlead can pick up noise signals, which are stronger close to the ground and in buildings.

Distribution amplifiers are differentiated from preamplifiers in that they have, in general but not necessarily, a higher gain and can handle larger outputs. Since they are designed for gain, particular attention is not paid to low-noise input stages. A good rule of thumb, which should cover most cases, is that a distribution amplifier should not be fed with less than 1000 μv. of signal. If low antenna signals are prevalent in the area of use, such amplifiers must be preceded by a preamplifier to develop proper input levels.

The higher gain of distribution amplifiers means that longer lines can be run from their outputs, which brings us again to the problem of differential loss in coaxial cable. Some form of compensation is necessary to reduce this effect to a point where it does not affect the system. The problem is attacked in two ways, the most direct being the use of a compensator network. This is a frequency-sensitive attenuator (whose characteristics are the opposite of the

128 pages 200 illustrations

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CAP. (μμfd.)	CH.2		CH.6		CH.7		CH.13	
	I	FT	I	FT	I	FT	I	FT
.47	42	*	34	*	33	*	29	*
1.0	34	*	28	*	26	*	22	.05
2.2	27	*	21	.1	17	.11	15	.15
3.3	22	.06	18	.12	14	.25	11	.5
5.0	19	.12	16	.2	11	.54	9	.9
6.8	16	.17	13	.3	9	.91	6	1.5
10.0	13	.3	9	.6	Not used in this band			

* = Insignificant loss; I = Isolation loss in db; FT = Feedthrough loss in db.

Table 2. Capacitor values commonly used in tap-off units, with their losses.

cable characteristics) which is placed between the amplifier and the line.

We should re-examine the cable from this viewpoint. Fig. 10A shows the behavior of a 1000-foot section of RG-11/U, using the level of channel 2 along the cable as a reference level. The loss at channel 2 in RG-11/U is 1.6 db per 100 feet and, in a 1000-foot length, the total loss will be 16 db. At channel 13, loss is 3 db per 100 feet, making a total of 30 db. The *delta*, or rate of change is 30-16, or 14 db per 1000 feet. At the end of this cable, the channel-13 signal will be 14 db less than whatever channel-2 signal remains.

If we construct a compensator which has a reverse *delta*, so that it attenuates channel 2 by 14 db at the amplifier output, then we will have the situation of Fig. 10B. In this situation, the level of channel 13 is higher all along the line, becoming even with the channel-2 signal at the end. Fig. 10C outlines a compromise method, where the compensator corrects for one-half of the cable *delta* (7 db). In this case, channel 2 is attenuated 7 db at the beginning, thus starting 7 db *down* and arriving at the cable end 7 db *up*. Manufacturers using these methods will specify the length and type of cable for which a given cable compensator or *line equalizer* is designed. Tap-off units on such a line, with their feedthrough losses, usually change situations to the extent that the prediction of actual levels shows considerable error. In general, the effect of tap-off units is to make a line appear longer and have a greater *delta*.

A more elegant and less energy-wasting solution is offered in the "tiltable" distribution amplifier. To explain the term "tiltable," we can refer back to Fig. 9, the response curve of the broadband preamplifier. Except for the amount of gain, the response curve of a broadband distribution amplifier will be very similar. Note that the top of the response curve is flat, indicating equal gain at all channels between the markers. If the top of the curve is tilted, so that the higher channel markers are higher than the lower channel markers, then the amplifiers would have more gain at the higher frequencies and a correspondingly greater output. If the tilt is across a pivot point located at the center of the band, the average gain and the composite developed voltage would remain the same. The difference in gain between band extremities could be made one-half of the *delta* of a given length of cable, with or without tap-off units, thus arriving at the optimum condition. Such amplifiers can be made with a single "tilt" control for each band which, with individual gain controls for each band, allows the amplifier to compensate for any practical length of the cable. The method is extremely flexible.

One such amplifier is the *Jerrold* Model 2300. It is factory-adjusted to compensate for either 800 feet of RG-11/U or 400 feet of RG-59/U, since each of these lengths requires the same compensation. The tilt actually required for a given use can be set easily with an alignment tool and meter.

(To be concluded)

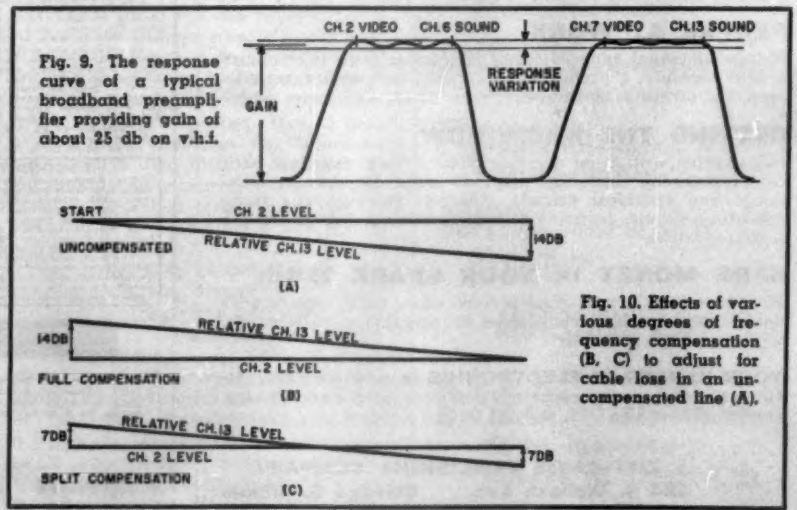


Fig. 9. The response curve of a typical broadband preamplifier providing gain of about 25 db on v.h.f.

Fig. 10. Effects of various degrees of frequency compensation (B, C) to adjust for cable loss in an uncompensated line (A).

What's New in Radio

NEW "FLEETCOM" SERIES

Communications Company, Inc., 300 Greco Ave., Coral Gables, Fla. has announced a new line of v.h.f. FM equipment for use in the new "Business Radio Service" band recently authorized by the FCC.

The "580 Series" equipment features a transistor power supply and a single-chassis receiver/transmitter unit. An

a.c. adapter is available which permits the receiver/transmitter chassis to be removed from a vehicle and used as an a.c. base station. The mounted unit is only 15¼" wide, 10¼" high, and 11½" deep. The transmitter output is 50-60 watts in the 25-54 mc. range and approximately 35 watts in the 144-174 mc. band.

The manufacturer will supply full details and complete specifications on this new equipment for "Business Radio Service" applications upon written request.

V.H.F. CONVERTER

Radio Manufacturing Engineers, Inc., Division of *Electro-Voice, Inc.,* Buchanan, Mich. has developed a v.h.f. converter with its own power supply which

has been designed for use with any conventional communication-type receiver to extend its range to cover 50 mc., 144 mc., and 220 mc.

The function of the VHF126 unit is to convert the very high frequencies received to a fixed frequency of 7 mc. which is then fed to the receiver, amplified and detected in the normal manner. For the two higher ranges, double conversion results. On all ranges the image response is practically eliminated

since the output is 7 mc. and the first i.f. for the fixed-tuned crystal-controlled unit is 50 mc. The auxiliary controls on the receiver, such as the b.f.o., noise limiter, r.f. and audio gain, plus the "S" meter will function in the normal manner. The 220 and 144 mc. converters employ overtone series-mode crystal oscillators and one doubler.

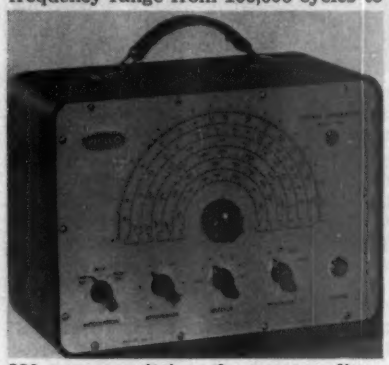
The range of the unit is 48.2-54.2 mc.; 143.4-149.2 mc.; and 219.4-225.2 mc. This provides complete coverage of the 1¼-, 2-, and 6-meter bands with sufficient overlap on 6 meters to listen to commercials for band openings. The unit also covers MARS and CAP frequencies on 2 meters.

For a data sheet with complete specifications, write the manufacturer direct.

PHILCO'S SIGNAL GENERATOR

The Accessory Division of *Philco Corporation*, "C" and Westmoreland St., Philadelphia 34, Pa. has announced the availability of a new service signal generator, the Model 7200.

This new AM-r.f. unit covers the frequency range from 100,000 cycles to



280 mc. permitting the proper alignment of TV oscillator coils on all channels. The generator can also be used as a marker at r.f. or i.f. frequencies in all television receivers.

The circuit provides high uniform output and stable operation. The housing features large clear panel markers which will never rub off, baked enamel finish, etched aluminum panel, and large vernier scale.

Further information on this new service instrument is available either from local distributors or Ray Nugent, general manager of the Division.

"HI-KAP" DEALER KITS

Centralab, a division of *Globe-Union, Inc.*, 900 E. Keefe St., Milwaukee 1, Wis. is currently offering four new dealer kits in its "Hi-Kap" ceramic capacitor line.

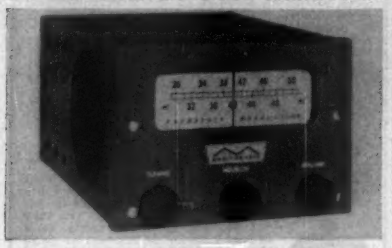
These heavy-gauge steel kits contain balanced inventories of the most frequently used ceramic capacitors. Individual values are prominently and clearly labeled so that the right capacitor can be located instantly. A rigid plastic package permanently separates each value and protects the units so the leads are always straight. The package is constructed so that it can be easily opened to remove a single

capacitor and then replaced in its proper location in a few seconds.

The four kits being supplied are the DCK-200 which contains 200 tubular ceramic BC units; the DDK-200 with 200 standard ceramic disc capacitors; the TCK-80 kit with 80 temperature-compensated units; and the HVK-150 with 150 high-voltage disc units. The cabinets are supplied with the kits at no additional charge.

TUNABLE MOBILE RECEIVERS

The *Monitoradio Division* of *I.D.E.A., Inc.*, 7900 Pendleton Pike, Indianapolis, Ind. has released two new tunable mo-



bile receivers which operate in the 30-50 mc. and 152-174 mc. emergency communications bands.

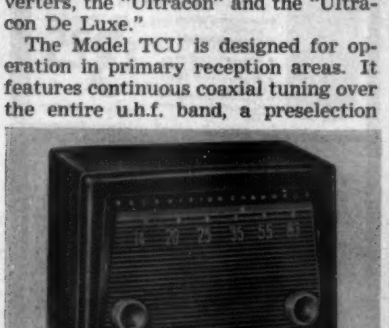
The Model M-40 is for the 30-50 mc. band while the Model M-160 covers the 152-174 mc. band. Both of the receivers feature double-conversion, tuned r.f. stages, 2 μv. sensitivity, and built-in squelch adjustable from the front panel. Both have built-in 4-inch speakers and illuminated slide-rule dials. The units are housed in durable metal cabinets measuring 4½" x 6½" x 8¾".

For complete details, write the Division direct.

U.H.F. CONVERTERS

Jerrold Electronics Corporation's Distributor Sales Division, 15th Street and Lehigh Ave., Philadelphia 32, Pa. is currently offering two new u.h.f. converters, the "Ultracon" and the "Ultracon De Luxe."

The Model TCU is designed for operation in primary reception areas. It features continuous coaxial tuning over the entire u.h.f. band, a preselection



stage which is a prerequisite for reception in areas with two or more v.h.f. or u.h.f. channels, a 6AF4A oscillator tube, a low-noise mixer diode, and a slide-rule dial coupled to vernier tuning for easy station selection.

The Model FTC is a deluxe u.h.f. converter designed specifically for reception in poor signal areas. The unit combines high-gain amplification with low-loss circuitry. For local area reception, this unit contains a built-in

u.h.f. antenna. The heart of this converter is a radar-type, coax tuner which is completely sealed and does not contain any wiper contacts, switch contacts, or any other components causing signal noise.

Both converters are housed in compact, modern cabinets designed to complement any decor.

CIRCULAR SLIDE-RULE

General Industrial Co., 5738 N. Elston Ave., Chicago 30, Ill. has just introduced a handy circular slide-rule designed specifically for engineers and other plant and office executives.

Operation of the rule is simple and the results are accurate. To multiply, divide, and find proportions is a matter

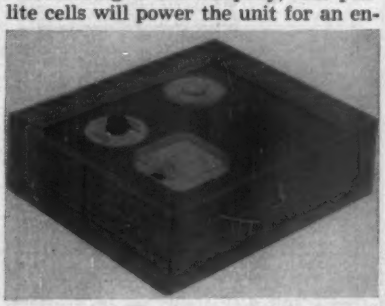
of seconds. Complete easy-to-follow instructions are included with each rule.

Engineers and business executives may receive the rule free of charge upon letterhead request. Others who would like this pocket-sized calculator can obtain one by writing the firm, enclosing 50 cents in coin to cover the cost of mailing and handling.

MARINE DIRECTION FINDER

The Marine Equipment Division of *Parametrics*, P.O. Box 629, Costa Mesa, Calif. is now marketing an all-transistor radio direction finder under the tradename "Port-A-Finder."

According to the company, four penlite cells will power the unit for an en-



tire season. The instrument is housed in a solid mahogany case which measures 8" x 9" x 3".

Designed for sensitive reception of marine radio beacons, radio telephones, and standard broadcast stations the unit can also function as a portable receiver for entertainment purposes.

For complete specifications and price, write direct to the manufacturer.

TRANSISTOR-CIRCUIT OHMMETER

Electronic Applications, 194 Richmond Hill Ave., Stamford, Conn. is currently offering a direct-reading ohmmeter which has been especially

designed for transistor circuit applications.

The EMT-321 provides minimum loading (under 30 mv. to 300 ohms),

and covers a range of 10 milliohms to 10 megohms in eight steps. A single scale is used to read all ranges. Accuracy is ± 2%.

The unit measures 8½" x 6" x 4½". Free literature and information on price are available direct from the company.

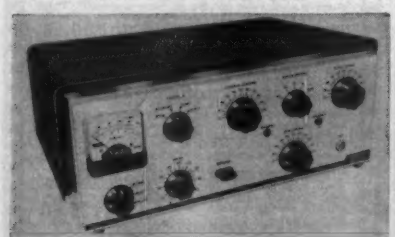
90-WATT C.W. TRANSMITTER

Electronic Instrument Co., Inc. of 33-00 Northern Blvd., Long Island City 1, N. Y. has added a 90-watt c.w. band-switching amateur transmitter to its *EICO* kit and factory-wired line of equipment.

The Model 720 transmitter will tune 80 through 10 meters yet is compact enough to be used in relatively cramped quarters. The tube line-up consists of a 6146 final amplifier, a 6AQ5 clamper that protects the final amplifier when loss of excitation occurs, 6CL6 oscillator, a 6AQ5 buffer multiplier, and a GZ-34 full-wave rectifier.

The circuit incorporates one-knob bandswitching; one-knob power, tune, and operate switch; final amplifier grid drive control without detuning the oscillator; oscillator keying for break-in operation; no shock hazard at key terminals; completely sealed cabinet and carefully bypassed and choked input and output leads for TVI suppression; plus "Novice limit" calibration (75 watts) on the meter.

External plate modulation terminals are provided to permit use as an AM phone transmitter delivering up to 65



watts plate power input with the company's Model 730 high-level class B universal modulator. A basic v.f.o. unit will be offered at a later date.

The transmitter measures 5" high, 15" wide, and 9" deep. The kit is supplied with complete assembly and operating instructions—the wired unit with full details on operation. —30—

Service Industry News

VINCENT LUTZ, head of *Lutz TV*, St. Louis, Missouri, was elected president of NATESA at its recent annual convention in Chicago. He succeeds Russ Harmon of *Weber TV*, Cincinnati, Ohio. Mac Metoyer of *A One TV*, Kansas City, was re-elected to the post of secretary general, and Nelson Burns of *Burns TV*, Memphis, Tennessee, was renamed treasurer.

Regional executives elected by the delegates include: Bert Bregenzer of *Penn Radio & Sound*, Pittsburgh, Pa., eastern vice-president; Cordell Britt of *May TV*, Nashville, Tenn., east-central vice-president; Wayne Lemons of *A One TV*, Buffalo, Missouri, west-central vice-president; and Winston Haines of *E & H TV Service Co.*, Burlingame, Calif., western vice-president.

Regional secretaryships went to: Irving Toner of *Toner Radio & TV*, Buffalo, N. Y., eastern region; Albert Mirus of *Mirus TV*, Cincinnati, O., east-central division; W. E. Johnson of *Johnson Radio-TV*, Beaumont, Texas, west-central division; and O. W. Andrews of *Rocky Mountain Radio-TV*, Denver, Colo., western division.

New Midwest Group

The Midwest Electronic Alliance has been organized by dealers long active in association work to serve as a regional instrument for Ohio, Indiana, Michigan, Illinois, Wisconsin, Minnesota, Iowa, and Missouri. Vern La Plante, former president of the Electronic Technicians Association of Toledo and current editor of "ETAT News," 1952 Sylvania Ave., Toledo, Ohio, was elected president. Howard Wolfson, chairman of the Associated Radio & Television Servicemen of Illinois, 433 South Wabash Ave., Chicago, Ill., is secretary-treasurer. John Glass, president of The Electronic Association of Missouri (TEAM), 4134 Easton, St. Louis 13, Mo., and W. C. Pecht, editor of "TEAM News," Frank Teskey and Robert Sickels, co-editors of the "Hoosier Test Probe" (Indianapolis Television Technicians Association, 1859 S. East St., Indianapolis, Ind.), were all active in the formation of the new group.

In creating MEA, its organizers emphasize that the alliance is to be purely regional. The objectives of the associations with which MEA officers are identified are to help develop more local associations and to strengthen their state-wide organizations.

Know Your Fellow Members

An unusual plan for getting members to know each other better was recently inaugurated by the Asso-

ciated Radio-Television Service Dealers of Columbus, Ohio. It is the "Gad-A-Bout" Contest. Cash prize awards of $10.00 and $5.00 are given to members who visit the most shops and turn in the most comprehensive reports.

Each member is given a "Gad-A-Bout" Contest blank on which are listed the names of all of the member shops. Members are urged to visit as many shops as possible and to report on what they like best about each shop they visit. The report must be signed by each shop owner whose shop is visited. In addition to getting to know each other better, ARTSD members feel the "Gad-A-Bout" plan stimulates the exchange of ideas among members.

Further information about the "Gad-A-Bout" Contest program may be obtained by writing John P. Graham, editor "ARTSD News," 2552 North High Street, Columbus, Ohio. (Send a stamped, return envelope.)

Bait Advertising Stopped

The Code of Ethical Standards for advertising TV service that has been in effect in St. Louis, Mo., for several years served as an effective barrier against the spread of a bait service advertising deal that had been introduced in Kansas City, according to "TEAM News," official publication for The Electronic Service Association of Missouri. The "News" reported:

"When the details of the Kansas City tube checking deal were given to the advertising media of St. Louis, it was agreed that any firm operating on this basis would have to conform to the ethical standards set up four years ago. These standards have been effective in making St. Louis one of the cleanest areas for TV service.

"As a result of those standards a few firms who tried to use the 'free' gimmick were turned down by *The Post Dispatch, The Globe Democrat,* and the TV stations.

"The censors of the newspapers and the TV stations took commendable action in upholding these standards in the best interest of the public."

Free Tube Testing

The Western Electronic Association of Cheyenne, Wyoming, recently launched a campaign offering free tube testing to channel business into the shops of the seven firms that make up its membership.

The organization's ad campaign invites the public to take its tubes to any of the member shops, where they will be tested free by trained technicians on professional equipment. The ads also point out that, when a tube fails, the cause should be corrected before a new tube is put in service. They stress the fact that electron tubes sometimes burn out from causes other than age and correcting the cause of the trouble is as important as replacing the tube.

Members of the Cheyenne association are: *D. C. Radio & TV; Del-*

haute's Radio & TV Repair Service; Clear-Vue TV; Ray Park Radio & TV; Bob's Radio & TV Quick Service; Kremer's Radio & TV and Fine TV Sales & Service.

NATESA Passes 100 Mark

A reorganized television service group centering in Texarkana, Texas, was reported to be the one hundredth association to affiliate with NATESA. The group, formerly known as the Four-State TV Service Association, is made up of service dealers and technicians operating in Texas, Oklahoma, Arkansas, and Louisiana. Ward Brackeen, operator of a service firm in Texarkana, is president. Other groups have since joined NATESA.

California Elections

James Wakefield, owner of *Cardinal Electronics Service* of Fresno, Calif., was elected president of the California State Electronics Association at the organization's third annual convention. He succeeded H. Lawrence Schmitt of the *Lloyd Wollmer Co.*, Burlingame, Calif. Mr. Schmitt was named to the new post of executive secretary.

Other new officers of CSEA are: Ray Warthen of the *Electronics Service Co.*, Vallejo, vice-president; and Art Blumenthal of the *Art Blumenthal Co.*, Redwood, secretary-treasurer.

Louisiana Licensing

The state legislature of Louisiana recently passed a law requiring all radio and television repairmen in cities of over 20,000 population to take an examination and be licensed by a new state radio and television technicians' licensing board. The board is to include eight members named by companies in the radio-TV service field and three named by an electrical union.

The Louisiana law is the first statewide measure of its kind. However, it does not cover service people in communities under 20,000 population nor those operating in rural areas. Association officers feel that, when technicians in the smaller communities understand the beneficial features of the law, they will support a revision to make the law completely state-wide at the next session of the legislature.

Manufacturers' Warranties

The focal point of practically all service association programs during the coming months will be a determined effort to stop the trend among manufacturers toward extending the time of parts warranties and "no-charge" service on their products. Pointed editorials covering all facets of manufacturers' growing incursion into the service field have appeared in such prominent and widely read service association publications as the "TSA News," Television Service Association of Michigan; "TEAM News," The Electronic Association of Missouri; the "Hoosier Test Probe" of the Indianapolis Television Technicians Association;

and the "Radio-TV Technicians Guild News," official publication for the Radio & TV Technicians Guild of Florida, Inc.

It is apparent, too, that the independent parts distributing industry is getting very much concerned over the trend toward extended service and parts warranties. The officials of the Keystone chapter of the National Electronic Distributors Association unanimously agreed at a recent meeting that any further extension of the TV-radio manufacturers' free parts and labor warranties "would not be in the best interests of consumers or the industry."

Ty Yonkers, president of the Keystone chapter of NEDA, brought this matter to the attention of Col. Gail Carter, executive officer of NEDA, in a letter to the national office requesting the national group's support.

In addition, Mr. Yonkers wrote, "an extension of these policies would work undue hardships on the independent service facilities and on the independent parts distributors.

"The Keystone chapter," he said, "therefore requests that NEDA, through its officers and your office vigorously oppose . . . any efforts by the set manufacturers to extend their warranty on parts, tubes, and labor beyond 90 days on the set and one year on the picture tube."

Service with a Heart

Among the many important contributions to community life made by the organized electronic service industry are those that do much to help people who are unable to help themselves. This news account from Detroit, Mich., tells a heart-warming story:

"TSA, upon learning that many of the TV sets at the Veteran's Memorial Hospital in Southfield were inoperative, informed their members of the need. A date was set and the job was done on Tuesday, July 15. The members responding were:

"Chase Television Service, Inc.; Circle Radio & TV; Dexter Sales & Service; General TV; H & M Electric Service; Lang's Radio & TV; New Center Electric; Personalized TV; Progressive TV; and *Supreme TV.*

"They met on the steps of the hospital and were directed to the inoperative sets throughout the wards by Mr. Warren A. Cushing, Director of Special Services for the Hospital. About two hours later the job was done. The satisfaction derived was far greater than the small amount of time expended.

Honorable Rivalry

W. C. Pecht, editor of "TEAM News" (The Electronic Association of Missouri), congratulates "The Raster," published by the NATESA-affiliated rival in St. Louis, on its improved quality. "While this association, TEAM, feels quite differently on the subject of licensing," he says magnanimously, "we do admire efforts toward upgrading the service industry." —30—

Mac's Service Shop

(*Continued from page* 68)

you listen closely, it's easy to see that the 's's' can be heard much more easily in speech when the receiver is tuned in this fashion than is the case when it is tuned in the ordinary way.

"What's more, you can flip from one sideband to the other without there being a bit of difference in reception, providing, of course, there's no QRM on one side or the other."

"What if there is QRM?"

"That's one of the beauties of setting up the receiver in this manner. If a station comes on near the one to which you are listening and puts a high-frequency heterodyne on the signal, you can usually lose the heterodyne entirely by simply switching to the other sideband. You don't have to touch the tuning when you do this. Neither do you have to retune when varying the selectivity of the receiver. In fact, you can give interference a real battle without ever touching the tuning dial. First you switch sidebands to try to get rid of the interference. In the event that stations are crowding in on both sides of the one you're trying to receive, you can narrow down the bandwidth of the receiver. If a single source of interference still persists, you can finally try to notch it out with the tunable *T*-notch filter."

"Do you always have to use the b.f.o. to place the carrier correctly?"

"You do to place it exactly, but after you get on to it you can come pretty close simply by tuning the receiver to the proper side of the signal being received. With my receiver, and a couple of others that are of the same general design, you tune to the high-frequency side of the signal when using the upper sideband position and to the low-frequency side in the lower sideband position. When I am just tuning around, I never bother to use the b.f.o. to set the carrier; but when I get into a QSO, I usually flip on the b.f.o. for a second or so and zero-beat exactly."

"Is it always desirable to place the carrier down on the skirt of the passband?"

"Practically always. I've found that when you're copying an extremely weak DX station you can sometimes pull it in just a little better by moving the carrier to the top of the passband. You know the same thing happens in ultra-fringe-area TV reception. Sometimes you have to sacrifice optimum normal-signal tuning—and even alignment—to get a picture at all; but these cases are exceptions to the rule."

"I'll bet your knowledge of a TV set, which is actually very close to being a single-sideband receiver as far as the picture is concerned, helped you considerably in understanding the working of your new receiver."

"You can say that again! In fact, I have a heck of a time trying to explain what is going on in our sideband receivers to another ham who hasn't

swallowed at least a little TV theory."

"That's fine," Mac said as he picked up his solder gun. "Now let's put some of your excellent grasp of TV theory to practical use. See what you can do with that portable set that has a nasty case of vertical jitter."

"Do you always have to be so dog-gone practical?" Barney grumbled as he placed the set on the bench.

"Well, Buster," drawled Mac, "I don't suppose I really *have* to be practical, but just as a matter of record it is your jam and cake I'm thinking about as well as my own bread and butter!" —30—

WANT TO MONITOR A SATELLITE?

By CHARLES T. McCORMACK

THE owner of any standard FM receiver can modify it, by means of a simple circuit addition, to allow reception of U. S. satellite signals. The modification does not interfere with the normal operation of the receiver in tuning regular FM stations.

The added circuit requires the use of six inexpensive parts mounted on a terminal board. Suggested values are given on the schematic below. Capacitor C_4 may be any value from 22 to 47 $\mu\mu$fd. but should fall within this range to give maximum audio output with minimum disturbance to the present circuit.

Mount the parts on the terminal board and the board in a convenient place on the FM chassis. If desired the circuit may be used "outboard" with leads connecting it to the FM chassis.

Locate the plate lead on the last i.f. stage of your FM receiver. Attach lead (A) from capacitor C_4 in the diagram to the tube socket pin for the plate of this last i.f. stage. Do not remove or interfere with existing connections to this tube socket pin.

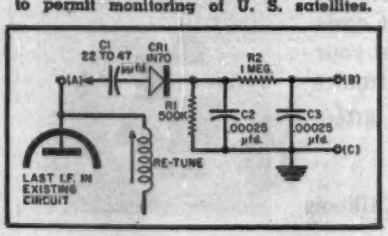
Next locate the input to the first audio stage in your FM receiver. Attach lead (B) to the primary side of this first audio component then connect lead (C) to any convenient ground on the FM receiver chassis.

The majority of FM receivers incorporate a ratio detector. In case your tuner uses a discriminator instead of ratio detector, lead (A) will have to be connected ahead of the first limiter in the set.

Now go back to the plate terminal of the last i.f. tube where lead (A) was connected. Trace an existing wire from this tube socket terminal to the primary side of the transformer. Retune the primary side of the transformer slightly for optimum FM operation.

To receive satellite signals, turn the dial of your FM tuner slightly above 108 mc. and listen! —30—

Two-dollar's worth of parts and you can build an attachment for your FM receiver to permit monitoring of U. S. satellites.

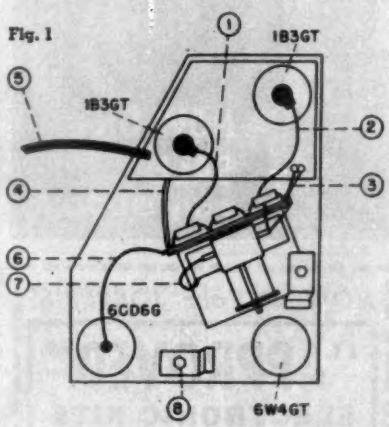


ANDREA: ARCING & BURNING

Whenever any work is done in the high-voltage compartment of a receiver using the VL-16 chassis, even the replacement of a tube in this section, care should be taken to maintain proper lead dress. Particular caution should be used to make certain that any wires connected to tube caps do not touch any portion of the metal cabinet or any other components. The penalty for failing to observe this rule may be arcing and burning.

To clarify questions concerning wiring layout, Fig. 1, illustrating proper lead dress, is shown here. Wires 1, 2, 5, 6, and 7 must be kept in the clear. They must not rest on other components or on the side of the compartment. When parts to which these are connected must be replaced, make leads short and direct, but do *not* put a strain on the parts. Wires 3 and 4 must not be pulled too tightly.

Fig. 1



Be sure to round off soldering connections on any work done in this area. Also, adjustment of the width coil (8, in the diagram) should be done with care. In no case should the slug for this component be turned too far out. This may lower the impedance of the coil to the point where it will overheat, and even burn out. If it is necessary to overadjust this slug to obtain proper width, other causes and other remedies should be investigated.

HOFFMAN: A.F.C. DETUNES FM

A simple but puzzling symptom may occur on model 8000 hi-fi receivers. After an FM transmission has been tuned in in the normal way with the selector switch in the "FM" position, detuning may occur when the switch is turned to the "FM-AFC" position. The remedy, although simple, is not immediately obvious. Actually the symptom occurs when the ratio de-

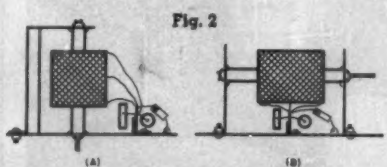
tector, because it is somewhat out of alignment, becomes sensitive to slight changes. Misadjustment of the secondary is generally the immediate cause. A slight re-alignment will prevent the detuning effect.

NATIONAL: HI-FI TUNER HUM

If hum is noticed in the AM function only of the "Criterion" tuner, it may be getting picked up by the 10-kc. whistle filter. To make sure that the hum in question is indeed being induced in the whistle-filter coil, short out the coil while checking for a change in hum level. This observation is best made with a meter.

If it has been determined that pick-up by the filter coil is the cause of the hum, the whistle-filter assembly, shown as originally mounted in Fig. 2A, will have to be positioned as in Fig. 2B. To do this, remove the coil

Fig. 2



mounting bracket and disengage the slug cap from the chassis. Interchange the slug caps at either end of the coil form.

Use two brackets to re-mount the whistle filter in its new position. Two #28 holes will first have to be drilled in the back of the compartment. It may be necessary to re-peak the coil with a 10-kc. test tone, but the variable resistor in the compartment will often provide enough latitude to make this alignment unnecessary.

For this remedy to be successful, the coil must be positioned properly with respect to the hum field. If little or no improvement is noted, turn the coil over by 180 degrees.

MOTOROLA: VIDEO HUM

When hum bars appear in the picture on receivers using the TS-542 chassis, don't overlook this possibility, which is not immediately evident: capacitor C_{31}, a dual 800-$\mu\mu$fd. unit in the tuner, may be guilty. One section bypasses the screen grid of the 5U8 mixer-oscillator tube. The other section bypasses the filament. Don't eliminate the possibility because the two sections, when checked separately, are found to be good. In spite of this, there may be enough leakage between the sections to couple enough 60-cycle filament voltage into the signal path to produce hum bars.

CBS-COLUMBIA: PIX OVERLOAD

Under certain conditions of transmission, it has been noted that a few receivers in the 700-series chassis will tend to overload at some settings of the contrast control. A slight modification of the video-amplifier circuit, involving changes in the value of two components, will take care of this condition. Change resistor R_{58} from 2200 ohms to 3300 ohms, and capacitor C_{58} from 390 $\mu\mu$fd. to 180 $\mu\mu$fd. —30—

A Transistorized Tracer

(*Continued from page 65*)

6-32 screws. These screws allow the board to be supported approximately ½" above the metal floor to prevent contact between the floor and the wiring under the board.

Two battery holders (*Philmore* No. 173) are mounted to the back of the front panel. (See Fig. 4.) Each of these holds two cells, which clip into place.

For space saving, a 1½" meter (*Cal-Rad* MO-38 or equivalent *International Instrument Co.* type) is employed. Similarly, a 1½" loudspeaker is used. (*Argonne* AR-95 or AR-99 if the matching transformer is included.) If the reader desires, a larger meter and speaker are permissible.

The r.f. probe is made with a heavy-duty test prod. Mount the diode and 270,000-ohm resistor close to the prod tip so that the RG-59/U shielded cable may be inserted into most of the length of the probe shell. This will place the cable in the part of the probe normally held between the fingers, and thus no further shielding will be required. The cable should be 3 feet long. At the opposite end of the cable, connect a concentric plug (*Amphenol* 75-MCIF) for insertion into the input jack, J_1, of the instrument. If the reader already owns a demodulator probe for use with his oscilloscope, this latter probe may be used as the r.f. probe for the signal tracer. The a.f. probe also should have a 3-foot cable of RG-59/U with a 75-MCIF plug on one end. The other end of the cable should be inserted into the same type of test prod used for construction of the r.f. probe, except that no diode or resistor is required. As in construction of the r.f. probe, insert the cable into the probe shell far enough so that its shielding extends as close as possible to the prod tip. This will provide good shielding for elimination of body capacitance effects.

The polarity of the diode in the r.f. probe is unimportant. However, be careful to observe the correct polarity of diodes CR_1 and CR_2 and meter M_1. If these connections are incorrect, downward deflection of the meter will occur. Also, connect the CK751 transistor correctly: The collector pigtail is adjacent to the red dot on the metal case. The positive terminal of the electrolytic capacitor, C_4, must be grounded. Connect the output transformer, T_1, exactly as shown by the color coding in Fig. 2. The center tap (red lead) is not connected in the circuit.

Capacitor C_1 is connected directly, by means of its pigtails, between input jack J_1 and the top terminal of potentiometer R_1. If the lead between the wiper of this potentiometer and resistor R_2 on the circuit board is more than 2 inches long in an individual layout, use a length of RG-59/U cable

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Tubes for above. Stock No. AS-403 ..... $4.16

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Ship. wt. 12 lbs.

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AKRON 8, OHIO**

grounded at one end. Such a length of cable is visible in Fig. 4.

Check all parts of the wiring carefully before inserting the batteries.

Test of Instrument

After the signal tracer is completed, test it in the following manner: (1) Open switches S_1, S_2, and S_3. (2) Connect a 400-cycle audio oscillator to input jack J_1 through the a.f. probe. (3) Set the oscillator output control to zero. (4) Set gain control R_1 to zero. (5) Set meter-sensitivity control R_2 to its high-resistance position. (6) Close switch S_2. (7) Set gain control R_1 to its maximum-gain position. (8) Close the "on-off" switch, S_1. (9) Set meter-sensitivity control R_2 to a point about a fourth of the way from its zero-resistance end. (10) Switch on the oscillator and, after it has warmed up, advance its output control carefully for full-scale deflection of meter M_1. (11) To check operation of the loudspeaker channel, open switch S_2 and close switch S_3. (12) To check combined operation of meter and speaker, close both S_2 and S_3. (13) With the signal applied to jack J_1, run the gain control (R_1) up and down to check its operation.

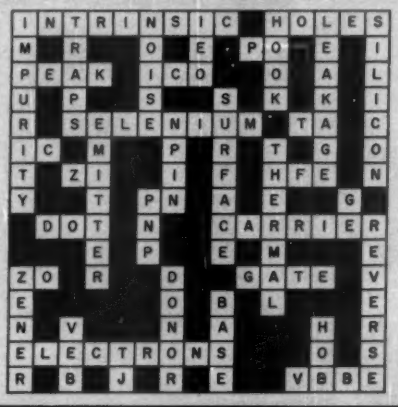
To check operation on r.f. signals: (1) Open all switches. (2) Connect an amplitude-modulated r.f. signal generator, set to 1 megacycle, to input jack J_1 through the r.f. probe. (3) Set the attenuator of the signal generator for zero output. (4) Set gain control R_1 to its maximum-amplitude position. (5) Close switch S_3. (6) Close "on-off" switch S_1. (7) Set meter-sensitivity control R_2 to a point one quarter of the way from its zero-resistance setting. (8) Switch on the signal generator and, after it has warmed up, advance its output carefully for full-scale deflection of meter M_1. (9) To check operation of the loudspeaker only, open switch S_2 and close switch S_3. (10) To check combined operation of meter and speaker, close both S_2 and S_3. (11) Run the gain control, R_1, up and down to check its operation.

Applications

The transistorized signal tracer is used in the same manner as a conventional tube-type instrument. Audio amplifiers and the a.f. channels of receivers and instruments are checked with the a.f. probe connected to the tracer. The test signal is supplied to the device under examination by an audio oscillator set to the desired frequency. Radio and TV receivers and other electronic equipment operated at radio frequencies are checked with the r.f. probe connected to the tracer.

When tracing a signal through the successive stages of a system, gain control R_1 may be turned down as points of higher amplitude are encountered, to prevent damage to the meter. When the gain must be adjusted to a maximum for good loudspeaker volume, potentiometer R_2 may be set separately to protect the meter under these conditions. —30—

Answer to Puzzle appearing on page 129



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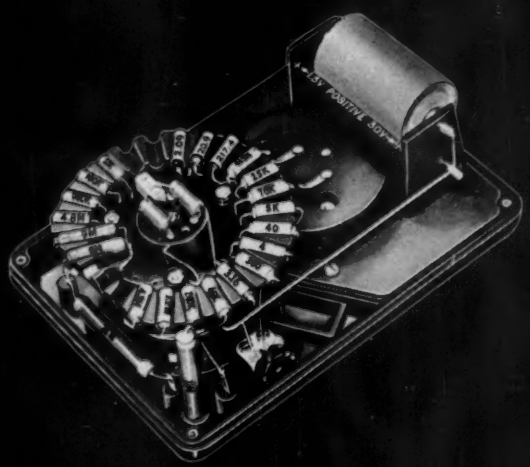

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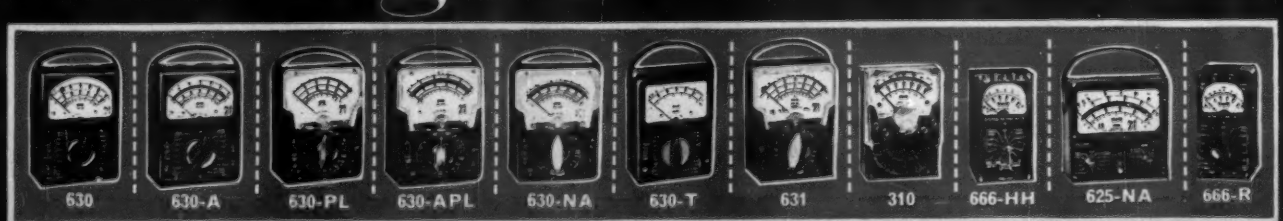

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